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1874-1885

THE TWENTY-FIRST

ANNUAL REPORT

AND

ABSTRACT OF PROCEEDINGS

OF THE

1878 + 1879
not issued

BRIGHTON AND SUSSEX
NATURAL HISTORY SOCIETY,

ADOPTED AT A MEETING HELD

THURSDAY, SEPTEMBER 10th, 1874.

PRICE ONE SHILLING.

BRIGHTON:
PRINTED BY FLEET AND BISHOP, "HERALD"-OFFICE.
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56, Middle-street.

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MR. R. GLAISYER,
The Dispensary, Queen's-road.

At the Twenty-first Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held at the Dispensary, September 10th, 1874,

IT WAS RESOLVED,—

That the Report, Abstract of Proceedings, and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the cordial thanks of this Meeting be given to the Honorary Secretaries and Honorary Librarian for their labours in preparing the same.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Alderman Cox; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. J. H. Brown, Mr. Benjamin Lomax, Mr. C. P. Smith, Mr. Dennant, Mr. Dennet, and Mr. G. D. Sawyer; Honorary Secretaries: Mr. T. W. Wonfor, 38, Buckingham Place, and Mr. J. C. Onions, 56, Middle Street; Honorary Librarian, Mr. George Scott; Honorary Curator, Mr. R. Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, Honorary Librarian, and Honorary Curator, for their services during the past year.

(Signed)
J. E. HASELWOOD,
PRESIDENT.

IT WAS ALSO RESOLVED,

That the warmest thanks of this Meeting be presented to Mr. J. E. Haselwood, for his able conduct as President during the past year.

REPORT.

In presenting the Twenty-first Annual Report your Committee have the pleasure of recording the continued prosperity of the Society, which has considerably increased in numbers during the past year. They regret the loss which the Society has sustained by the death of two of its members, viz., Mr. **Geere** and Mr. J. J. **Sewell**, the latter one of the Vice-Presidents and who had for many years taken an active part in promoting the prosperity of the Society.

The state of the finances is very satisfactory; for although the Committee have a balance of only 2s. in hand, they have been able to meet the exceptionally heavy expenses of the year caused by the necessity of purchasing book-cases to hold the books on their removal to the Free Library; and to expend the sum of £12 8s. 2d. in the purchase of new books and periodicals.

The following books have been presented to the Society during the year :—Tenth Annual Report of the Belfast Naturalists' Field Club, (from the Society) : Report and Proceedings of Eastbourne Natural History Society (from the Society); Journal of the Quekett Club (from the Society); Proceedings of Geologists' Association (from the Society); Annual Report and Proceedings of Maidstone and Mid-Kent Natural History Microscopical and Philosophical Society for 1874 (from the Society); Lists of the Local Fauna and Flora of Eastbourne, and Supplement to the same (from Mr. J. C. Roper); Summary of a Meteorological Journal, kept at Crowboro', by C. L. Prince (from the Author); Mild Medicines, by Dr. T. Massy (from the Author); Geology of Brighton, Part i., by J. Howell (from the Author); Quarterly Reports of Sub-Wealden Exploration (from the Secretary); Transactions of Smithsonian Institution (from the Institution); Recollections of Agassiz, &c. (from C. F. Dennet, Esq.); The Origin of some of the Lake Basins of Cumberland, by C. Clifton Ward, F.G.S. (from the Author); The Glaciation of the Northern Part of the Lake District, by J. Clifton Ward, F.G.S. (from the Author).

The following books have been purchased during the year:—The Norman People; Grafting and Budding; Tyndall on Heat; Linnean Society's Transactions, vol. 28, part iv., vol. 30., part i.; Geological Magazine; Zoologist; Entomologist's Monthly Magazine; Science Gossip; Monthly Microscopical Journal: Quarterly Journal of Microscopical Science; Popular Science Review; Quarterly Journal of Science; the Entomologist; Grevillea; Publications of the Paleontographical Society for 1873; ditto for 1874; British Annelids, by W. C. McIntosh (Ray Society's Publications, 1873 and 1874.)

The number of volumes in the Library is 800, exclusive of pamphlets and unbound current periodicals, and your Committee are pleased to learn the circulation of books continues to increase.

A numbered Catalogue of the Society's books has been prepared by Mr. G. Scott, and can be consulted at all times at the Library counter, while a shelf list has also been compiled, showing not only the position on the shelves of each work, but also the number of volumes.

During the year the Society's Microscopical Cabinet, which now contains 255 slides, has received donations from the following gentlemen: 13 slides from Mr. W. H. Smith and 4 from Mr. Wonfor. And your Committee report with pleasure the increased interest taken in the Microscopical meetings, and, as will be seen by the annexed proceedings, that very valuable papers have been read at them.

The Conversazione held in the month of February, at the Royal Pavilion, was very successful, both in the number of those who were present, and in the variety and character of the entertainment.

Your Committee report that scarcely any response has, up to the present time, been made to the circular inviting assistance in verifying the Fauna and Flora of Sussex, as suggested in Mr. Wonfor's paper of April 10, 1873, but they hope at the next Annual Meeting to present a more favourable report.

The thanks of the Society are due to the Brighton and Hove Dispensary and the Medico-Chirurgical Society, for the use of the room at the Dispensary, in which the Meetings of the Society were held up to March last.

Your Committee have great pleasure in commemorating the fact that since the last Annual Meeting the Free Library and

Museum has been opened to the public, and that upon the opening ceremony the Mayor (Mr. Alderman Ireland) gave a Soirée to over 3,000 of the inhabitants: when the chief part of the Microscopical and Scientific Instrument display was arranged, at the request of the Mayor, by this Society.

The thanks of the Society are specially due to the Town Council of Brighton for allowing the Society to take up its quarters at the Free Library and Museum, where its books have been deposited, on the condition that, while the Society shall hold its meetings in the Curator's room, the public may use its books under the same conditions as those in the Free Library, full rights being reserved to members of taking books home.

Your Committee are pleased to hear that the public have made great use of the Society's books since their removal to the Free Library.

The thanks of the Society are due to Mr. G. Scott, the Curator of the Free Library and Museum, for the valuable assistance he has rendered to the Society during the past year.

The thanks of the Society are due to those gentlemen who have read Papers, exhibited Objects, or presented Slides for the Cabinet, Photographs and Drawings for the Society's Album, or Specimens.

The Society is to be congratulated on the increased attendance at its meetings, the far greater accommodation afforded at the Free Library and Museum, and the growing interest taken by the Members in the welfare of the Society.

The Field Excursions since the last report have been as follows:—September, 1873, to Shoreham; October, to Glynde; May, 1874, to Balcombe; June, to Newick (by the kind invitation of J. H. Sclater, Esq.); July, to Henfield; August, to Shoreham.

The Annual Excursion took place on the 2nd of July to Groombridge, and being of a specially interesting nature, an account of it will be found in the subjoined proceedings.

In concluding their Report, your Committee beg to request the Members to endeavour to promote the prosperity of the Society by bringing its merits under the notice of their friends, by contributions of Works of Natural History to the Library, of Photographs or Drawings of objects of Natural History for the Album and of Slides for the Microscopical Cabinet, and particularly by reading Papers during the ensuing year.

ABSTRACT OF PROCEEDINGS.

1873–4.

SEPTEMBER 11TH.

ORDINARY MEETING—SPECIMEN EVENING.

On taking the Chair, the newly-elected President, Mr. J. E. **HASELWOOD**, said that as the Society had been the means of affording him much pleasure and gratification, he felt it his duty to respond to the request that had been made to him; but, as the members had elected him, knowing he had no special qualification, they must take the responsibility of the step in the event either of his Presidency being a failure or a success. He need hardly say, however, that he would do his utmost to fulfil the duties of the position, and he heartily hoped that the Society would have a prosperous career during the ensuing year.

Mr. G. **SCOTT**, in acknowledging a vote of thanks, said that when he was unexpectedly elected to the post he had just vacated, he determined to be as regular as possible in his attendance, and to try at least to preserve his equanimity of temper, whatever might arise. Fortunately there had not been a single opportunity of putting the latter resolution to the test, and, with regard to the former, he was glad to say that he had attended every ordinary meeting, he believed, except one, and then he was absent in Norfolk on an expedition by which he hoped the whole town would benefit. And that reminded him that a kindly reference had been made to his position as Curator of the Public Library and Museum. He wished to say that, when accepting this appointment, he felt a strong inclination to resign the presidency of the Society lest it should be thought to detract from its dignity. He was dissuaded, however, from doing this, it being pointed out that there was a very good precedent in the connection of Professor Edward Forbes with the Geological Society (applause), and he had certainly found since that advantages have arisen from the combination of the two offices. In conclusion, he could only say that he felt much pleasure in having such a successor as Mr. Haselwood.

Mr. F. E. **SAWYER** said he wished to remark that when he read his paper on Earthquakes in Sussex some time ago, he was not aware that Mallett had collected the particulars of every earthquake in the British Isles, of which there was a record. Having recently had an opportunity of inspecting Mallett's records, he was able to make the following additions to the list of Sussex shocks :—During the shocks in 1638, "the atmosphere was obscured as if by a cloud." In 1758, on January 24th, at two a.m., "a slight trembling, lasting but a moment," was felt "in the parishes of Worth and East Grinstead, accompanied by a rolling noise. The windows were made to rattle." This was recorded in vol. 50 of the Philosophical Transactions. In 1833, about the 2nd April, at 8.15 p.m., a shock of earthquake was felt at Horsham, and was "more perceptible in some houses than in others. Some persons were greatly frightened, whilst others felt nothing." The authority for this was Garnier, who quoted from a London letter of the 10th April, 1833. These two shocks, together with the one mentioned by Mr. Wonfor as occurring in 1692, increased the total number of shocks in the County to 21.

Another subject to which he wished to allude was the statistics as to the force and prevalence of wind in Brighton during the last year, the anemometer at the Pier Head having now been there twelve months. The distance travelled by the wind in September, 1872, was 11,633 miles; October, 10,436 ; November, 13,179 ; December, 12,174; January, 1873, 13,488 ; February, 7,667; March, 7,871 ; April, 8,760; May, 9,043 ; June, 7,962 ; July, 10,308 ; August, 12,846—total during the year, 125,367 miles, giving an average of 343 per day, or 14·3 per hour ; the maximum in one day was 904 miles, on December 8th, 1872. After this he could not help coming to the conclusion that Brighton is a windy place. At Rotherham the total is not above half so much but at Worthing it would seem to be about the same.

Mr. **SCOTT** asked whether these instruments could really be relied on ?

Mr. **WONFOR** pointed out that there was a very great difference between inland and coast towns, in consequence of the land and sea breezes. It was certainly very singular that less wind should be registered at Brighton in March than in any other month except February. He believed that Brighton suffered very much less from east-wind than places on the east coast, and that the prejudice respecting an east wind in Brighton was unfounded.

Mr. C. P. **SMITH** exhibited a new species of Solanum, obtained from Acton.

Mr. **PANKHURST**, flint spear head from Portslade, ironstone from Crowboro', curiously encrusted with a ferruginous coating, and silicified bone, said to be human, from Frome.

Mr. **CLAYTON**, fossils from the Brighton chalk pits, Sussex marble, and ancient iron crucifix from the Priory, Lewes.

Mr. W. **NASH**, iron nodules and chalk fossils from Amberley.

Mr. T. **GLAISYER**, a fine lump of Kauri gum, dug at the roots of the Kauri pine, New Zealand, almost in the condition of amber.

Mr. **WONFOR**, oak branch, partially stained green by the fungus *Helotium Æruginosum*. Oak thus stained is used in the manufacture of Tunbridge Wells ware.

Mr. R. **GLAISYER**, specimens of polished Sussex marble.

SEPTEMBER 25TH.

MICROSCOPICAL MEETING.—GENERAL EVENING.

A letter was read from the Mayor, Mr. **ALDERMAN IRELAND** thanking the Society for the assistance rendered at the Soirée given by him at the opening of the Free Museum and Library, Sept. 11th, especially with the Miscroscope, of which the Mayor remarked, "The gratification afforded by the Microscopic department has been a source of congratulation again and again." The Mayor's letter was ordered to be entered on the minutes.

It was also announced that the Lewes Natural History Society would hold a Microscopical Soirée on Monday, the 29th, at the

County Hall, Lewes, to which the Members of the Society were invited. It was thought, though the notice was short, that some of the Members would be able to avail themselves of the invitation, and take their microscopes with them.

The President, Mr. J. E. HASELWOOD, hoped, as this was the first Microscopical Meeting at which he had the honour to preside, the suggestion he was about to make would be favourably received, viz., that an evening should be occasionally set apart for practical instruction on some point in connection either with the mounting of objects or the manipulation of the microscope. He knew such evenings had been arranged in the past, when very valuable hints were given by some of the Members who had paid more attention than others to the microscope. One such evening he well recollected, when Mr. Hennah dissected out *palates* before them,—a practical lesson some of them were able afterwards to put in practice for themselves. He thought similar instruction would be not only appreciated but be very valuable to many whom he might call from their less practice, the younger microscopists.

Mr. WONFOR was sure, if it were indicated in what way some of them could help their fellow-workers, they would with pleasure render them assistance, as they had done on former occasions. One of the objects of setting apart one evening in each month for the microscope was to bring those Members who worked with it closer together, so that they might compare notes and give each other help.

Mr. F. E. SAWYER enquired whether any Member could give them instruction in cutting rock sections?

Mr. WONFOR feared none of their Members could help in cutting sections of the hard rocks, which required a lapidary's wheel; but as regarded the softer rocks, a plan he had illustrated some time since of rubbing down sections on sand paper of different degrees of fineness worked well. He thought some of the Members present had tried it with success and had obtained good sections, as well as of coal, a method of making sections of which he had also illustrated.

Mr. SEWELL thought Members would learn a great deal, if, after taking a practical lesson, they showed the results of their own work, their failures as well as successes, because they might then have pointed out wherein they had failed.

After various suggestions, it was resolved that the next Microscopical Meeting be devoted to practical instruction in "mounting in fluid," when it was hoped different Members would show how it was done.

The Meeting then became a Conversazione, when some very interesting and beautiful objects were exhibited by Messrs. R. Glaisyer, Hurst, F. E. Sawyer, W. H. Smith, and Wonfor.

During the evening Mr. Wonfor distributed among the Members present portions of the wings of butterflies and moths, and of the wing cases and bodies of beetles from the Museum, and which were in too broken and damaged a condition to be of any avail for Museum purposes, but which were thought might be useful to Microscopists.

OCTOBER 9TH.

ORDINARY MEETING.—DR. STEVENS ON SARSENS, GREYWETHERS, OR DRUID STONES.

DEFINITION.

Throughout the western chalk districts of England, and following more or less the lines marked out by the middle and lower series of the Tertiary Eocenes, masses of stone had been observed, in some places profusely scattered and of huge dimensions, in others sparingly so, and of comparatively insignificant size. Aubrey wrote of them under the head of Sarsden or Sarsdon stones; and considered that "the name owed its origin to a village near Andover called Sarsden, *i.e. Csarsdene*, perhaps *don*, Cæsar's-dene, Cæsar's-plaine, now Salisbury-plaine." There was another derivation from *Saracen*, meriting more respect. The Latin *Saxum* had been suggested as fixed to them in Roman times, subsequently corrupted to *Sarsen* by the Romanized Britons. Another derivation had been found in the Anglo-Saxon *sel-stan*, great-stone. One other solution, the Saxon *ses*, a stone, the plural of which, *sessan*, came very near to *săsen* or *sassen*, the name by which they were known among the Berkshire rustics.

The word Greywether evidently obtained its origin in the resemblance these stones bore to sheep, when distantly seen in scattered lines upon the Downs. As the stones on the Marlborough Hills all trended in the same direction, the idea at once took possession of the mind that it was a stream of rocks even yet moving onwards. In some places they lie hurled as it were at random over each other, as if they had formed the *débris* of an overwhelming avalanche, and in other places they were huddled one over another like the fallen ruins of some Cyclopean temple, or in scattered blocks as if thrown broadcast over the Downs.

The term Druid Stones referred especially to those Celtic monuments standing in detached places associated with Druidical rites.

DISTRIBUTION.

The space over which they were found comprehended a triangular patch on the world's surface, its apex resting in North Wiltshire, and its base on the German Ocean—from Margate to Lowestoft. Lying along its north and south flanks were bold hills of chalk, which probably overlooked this Tertiary area during the glacial period, when their bases were washed by the waves of a surging sea.

On looking over the Berkshire area, it would be observed that the Kennet extended from the Marlborough Downs, eastward, and joined the older and more voluminous Thames at Reading, this same Thames eating its way from north and west through the lower stratifications of the great Tertiary plane of marine denudation. It was in the western extremity of the basin, and extending for miles over an area west of Marlborough, and away northwards towards Swindon that the Sarsens chiefly abounded. So thickly were they spread over miles of country that the traveller might almost leap from stone to stone without touching the earth.

Their distribution in places, nevertheless, appeared somewhat patchy, rendering it difficult to determine for what reason in the same district one slope of a valley was strewn with them, another left bare. Some of the Sarsens from their unworn condition evidently rested near or at the original spots where they were consolidated. Such concretions were to be looked for wherever the Lower Tertiaries had found a footing.

ORIGIN AND STRUCTURE.

Various theories had been advanced to account for their origin, some of a very unlikely character; but some pointed to the idea that the Sarsens had been derived from the Woolwich and Reading series. Mr. Prestwich considered the evidence was in favour of their derivation from the mottled clays and sands overlying the chalk, known as the Plastic clay, from the Woolwich and Reading series; and based his conclusions mainly on the fact that the sands of these beds were of precisely the same mineral character as the blocks themselves—the concretionary stone representing, in each case, the component part of some portion of the Woolwich and Reading series.

Mr. Whitaker advanced the opinion, evidently based on sound observation, that the sandstone masses, lying on the downs west of Marlborough, owed their origin to the Bagshot sands, these sands having rested on the chalk of that district, whither they extended beyond the London clay, which clay thins off to nothing near Marlborough. In further evidence he had found these sandstones resting on the London clay, which intervened between the Bagshot sands and the Woolwich and Reading beds. It was remarkable that on this outside edge the sarsens largely predominated; and Mr. Whitaker's views were further strengthened by the fact that the blocks contained no fossils, whereas the underlying beds being in some cases fossiliferous, it was likely fossils would occasionally be found in them if formed wholly from these. At the same time, he coincided with Mr. Prestwich that some of the Conglomerates were referable to the Plastic clay.

The original idea that the greywethers of the Wiltshire downs were due to the Bagshots did not, however, rest with Mr. Whitaker, inasmuch as Smith, the parent of English geology, long ago advanced the opinion, that an extensive stratum of sand, containing these stones, once overspread the chalk of North Wiltshire.

Although no fossils had been observed in the greywethers, some peculiar root-like holes had the appearance of having come from marine plants. Their surfaces were in some instances pitted with basin-like hollows, somewhat resembling the depressions made in rocks along the sea shores, perhaps by the friction against pebbles lashed into motion by the waves. From the uniformity of structure in the Wiltshire sarsens it would almost seem as if they were the fragmentary remains of a continuous stratum that once had a wide range; but there could be no doubt that, in some instances, they had been agglutinated in separate blocks, much as we now found them. Many were angular and unrolled, and had evidently not travelled far from the spots where they were imbedded. They were further agglutinated together in nodules of all sizes, and of greater or less hardness.

The variety of material out of which they were constructed—in some instances worn or unworn flints, in others pebbles, forming pudding-stone, in others again fine ferruginous grit—evidently served to show that, under favourable conditions, almost any material formed the rough substance of the stones when brought in contact with the cementing material. Those recently taken from their sandy beds were not unusually coated with imperfectly solidified sand, merging into the character of the parent blocks, the process of accretion seeming to be the gathering together of the siliceous particles around the surface of the stones. There were doubtless differences in the chemical constitution of these consolidations.

Mr. Maw, in writing of such concretions found in the drift of Suffolk, stated that the hardest nodules were resolvable into sand by the action of hydrochloric acid, which seemed to imply that the cementing material was calcareous; and one block was found to contain only a very little lime in the shape of silicate. The Sarsens of Wiltshire had been found to be composed of very pure silex; their structure consisting of pure siliceous sand, agglutinated by a siliceous cement. They contained no carbonate of lime; and the trace of peroxide of iron found in them was due, probably, to the infiltration of ferruginous particles from the neighbouring soil, as the iron did not penetrate beyond the exterior of the stones, the interior being generally quite white. There appeared to be a total absence of saline matter. The weight per cubic foot was 154lbs.

There were good grounds for believing that the drifting of these stones was coeval with the formation of those widely extended patches of deposits, called "Brickearths," which had resulted from the breaking up of the older Eocenes. These drifts had received able exposition at the hands of Mr. Whittaker; and although many oscillations of level had taken place since their deposition, and considerable modifications of climate, there was very little doubt that the Brickearths were laid down at the close of the glacial epoch, at the time when the valleys were eroding, and the face of the land about to be made to assume its present contour—a period that immediately preceded the advent of man.

A good deal of high land in the neighbourhood of the Kennet was covered with a deposit geologically called "clay-with-flints," overlying which were brick-earths, intermingled with which, and lying in the clay-with-flints, Sarsens were often found. Now, these beds always occurred in hilly ground, and in the upper chalk. In accounting for the presence of the Brickearths it would be necessary to consider that, at an early date, the stratified Eocenes, of enormous thickness in places, occupied an arctic sea, or rather two small inland seas, for such the so-named London and Hampshire Basins might be considered; and that, by exposure to rapid currents, tides, and ice-floes, a large portion of the strata became denuded, leaving, as the waters shallowed by a gradual retiring of the land, masses of unstratified amorphous material over the face of the country. This same denudation left bare in places the Bagshot sands, London clay or Woolwich beds, as standing memorials of the wreck to which the Tertiaries had been exposed. This was succeeded by the scooping out of holes and pipes in the underlying chalk, which Sir C. Lyell and Mr. Prestwitch considered must be due to the solution and carrying away of the chalky material by water, charged with carbonic acid gas, derived from the decomposition of the vegetable matter, which must have largely overlaid the surface. This process continuing would in time be the means of removing immense masses of chalk, the calcified water escaping down the pipes into the reservoirs and gullies permeating the chalk hills.

At the time the pipes were forming the clay became precipitated into them, and mixing with the chalk-flints the whole graduated to the bottom, and formed the clay-with-flints. The Sarsens also dropped into the holes; and that portion of the clay which could not be absorbed into the clay-with-flints, remained on the top of the beds, and had been denominated Brickearth. Green and black-coated flints were not unfrequently found mingled with these deposits. Straggling pipes were further found in connection with these pot-holes, filled with coloured clay, derived probably from the decay of the chalk; and sand had also frequently worked its way down into the pipes with the clay. During the time the sand-pipes were forming the clay, sand, and other materials had gradually become washed away, and channels formed in the superincumbent chalk. Then followed the snow, rain, and tempest of Mr. Tylor's so-called "pluvial period," which tracked the footsteps of the sub-arctic period, and these persistent agents ultimately scooped out the chalk-valleys, and the Sarsens, dropping down as the valleys deepened, finally found their present resting places.

It had often been conjectured that the blocks were transported from great distances by glacial agency; but there was no sufficient grounds for such an opinion, inasmuch as the stones were all of one local formation; whereas far travelled ice-borne boulders would most likely include rocks of very diverse kinds. It was quite probable, however, that ground-ice might have been an agent in transporting some of the larger masses for considerable distances along the valleys. Indeed, the abrupt escarpments on some of the hill sides, in the course of the chalk-valleys, so different in aspect from the ordinary rounded outlines which characterise chalk districts, pointed to some grinding action in their production, and such as might have arisen from masses of ice formed at the bottom of the streams, and which rising to the surface laden with stones and gravel, were swept onwards with immense force by the flood-waters, scarping the valley projections in their progress. A paper by Engelhardt, of which a translation appeared in the "Smithsonian Report" for 1866, pointed out the consequences of these ice-drifts in choking the rivers, and during a rapid thaw, flooding the Rhenish and Danubian provinces.

This grooving process had left unmistakable evidence of its handiwork in the drift lying along the sides of the Kennet-vale, at a height of, in some places, 60 feet above the present valley level, showing that the stream had once occupied that height. Thus the upper and lower beds were of very different ages. And although some of the Sarsens were unworn and untravelled, others showed signs of rough usage from swift currents of long duration, as they were found in places, as on Inkpen Common, drifted in amongst heterogeneous materials, derived from every formation in the London Basin. At an indefinitely less distant period the present diminished stream commenced flowing through the valley. All these several conditions were not accomplished without much and diversified handling on the part of the many handmaids employed by Nature. The land rose slowly or by starts, the terraces, probably, marking the changes of level; and when the more powerful of the denuding agents had ceased their operations, the lower valleys had begun to retain the gravel obtained from the older gravel beds on the higher ground, and of the chalk beneath, and gradually the silt, mud, and lastly the peat, brought the face of the valley to its present quiet contour; and now the contracted river, supplied by a less rainfall, and a diminished valley-slope, flowed on without any great periodical change in volume or velocity.

USES.

From the time that the ancient Celtic people pastured their herds upon the Downs to the present hour, the Sarsen stones had been appropriated to very various uses. Spread broadcast over the face of hill and dale, and easily accessible, and other building materials not being immediately at hand, what more natural than that the primitive Briton should have selected those fashioned by Nature to suit his purposes, and with them built his temples, cromlechs, and memorial stones. It was found therefore that he availed himself of some of the most gigantic specimens for the erection of two out of the four circles of Stonehenge, and the whole of Abury, together with its mystic serpentine avenues, which were stated by Stukely to have consisted, inclusive of the circles of the temple, of 600 of these Sarsen masses, their individual weight probably averaging from 60 to 100 tons. Similar stones, not half a century ago, surrounded many of the Wiltshire barrows; but most of them had been since used up for road repairing, or for building purposes. One remarkable relic of ancient times was a holed Sarsen, standing under a tree by the roadside at Kingston Lisle, near the famous hill of the White Horse. It had long given the name of the "Blowing stone" to a wayside hostelry. The noise emitted by blowing into the upper part of the stone was so terrific, that if uttered in the silence of the night it must have effectually awakened the Saxon slumberers in the vale below.

Some of the Romanized Britons used these stones to build, by simple impaction, their villages on the Downs; one of which stood near Russley, a lonely spot not far from the old Ridgeway, a British trackway from time immemorial used by the Welsh drovers, with their cattle travelling out of the West of England. And yet again, the materials used by the Roman Britons had been carted away to construct the modern village of Baydon. Walls, barns, piggeries, cottages, mansions, churches, all had received a taste of the Sarsens of the Tertiary Basin. These massive blocks, therefore, consolidated in a sea-bed thousands of years before man's advent, and left stranded by the gradual retreat of the waters, all their concomitant sands, clays, and other oceanic sedimentary matters washed away from them, and after subsequent exposure for ages to the rude elements, used as building stones in the Pagan temple of the Celt, as well as in constructing the mansion of the modern English Noble, their past might fitly furnish a theme for the Geologist, the Poet, or the Antiquary.*

A cordial vote of thanks, proposed by the President, Mr. Haselwood, was given to Dr. Stevens, in whose absence the paper was read by Mr. Wonfor, one of the Honorary Secretaries.

In reply to an enquiry by Mr. Sawyer,

Mr. WONFOR said that specimens of Sarsen stone might be seen on the Dyke Road, and in several parts of Brighton, some of them being very large.

Mr. SCOTT mentioned that they were to be found on the Hollingdean Road, in the village of Stanmer, and in Moulscombe Farm, near the Lewes Road, the largest piece that he knew of being at the last-named place. These stones were sometimes used for dividing estates. He had brought with him several pieces as specimens.

Mr. WONFOR remarked that Mr. Alderman Martin had told him that three large greywether stones, originally standing at the top of

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* REFERENCES.—Aubrey's Natural History of Wiltshire. Stukely's Abury and his Stonehenge. The Drift near Marlborough, S. B. Dixon, 1867. Sarsens, Rev. T. Adams, Trans. Newbury Field Club, 1872. Memoirs of the Geological Survey, No. 12, Whitaker; also Memoir to sheet 34. Remarks on Sarsens, found near Southampton, Geolog. Mag., July, 1866, Lieut.-Col. Nicolls. Journal Geological Society, Prestwich, Vol. X. Journal Geological Society, Vol. 18, Whitaker Memoir 7 Geological Survey. Abury, Wilts Magazine, No. XII. Long. Maw on Consolidated blocks, Drift, Suffolk, Geological Repertory, Jan. 1867. The Kennet Valley, Professor Rupert Jones, 1854. Buckland, Transactions Geological Society, Vol. II. Camden's Britannia. Art. by Rev. W. Fox, Geologist, Vol. V. Physical Geology, &c., by Professor Ramsey, 2nd Edition, 1864. The Kennet Valley, Professor Rupert Jones, Trans. Newbury Field Club, 1872.

Clifton Hill, had been used for forming the base of the Fountain on the Steine, and another which had marked the boundary on the Dyke Road, had been carried away to form part of a fernery. A very large one used to stand in the Temple field, near Denmark Terrace, but it had probably been disposed of in the same way as a flint stone of prodigious size, that was once to be seen in Kemp Town—a hole having been dug into which it had been placed.

Mr. SCOTT, for the sake of eliciting Mr. Ward's opinion, said he thought that possibly ice agency had something to do with the distribution of the Sarsen stones, seeing that erratic blocks had been carried some hundreds of miles by the same agency. He thought that Dr. Stevens had rather ignored this.

Mr. WONFOR pointed out that the formations were known from which other erratic blocks came; but there was no known formation from which the Sarsens could come.

Mr. H. VERRALL pointed out several facts which militated against this theory; among others, there was no evidence of glacial action south of the Thames line.

Mr. J. CLIFTON WARD, F.G.S., Geological Survey, remarked that where rocks were deposited by ice agency many different rocks were found; but the greywethers were not mixed with other rocks. From a very close intimacy with ice-borne boulders, he felt pretty certain the Sarsens originated as Dr. Stevens had suggested.

Dr. CORFE asked if the stones of Stonehenge were not different from the greywethers? He had always understood so.

Mr. G. SCOTT: Most of them are greywethers; but some are not; these had been thought to be presentation stones.

OCTOBER 23RD.

MICROSCOPICAL MEETING.—DR. HALLIFAX AND MR. WONFOR ON MOUNTING IN FLUID.

In accordance with a wish expressed by the President, Mr. J. E.

Haselwood, at the previous meeting, Dr. Hallifax and Mr. Wonfor gave a practical lesson to the Members present on Fluid Mounting.

It was first pointed out that failure in securing permanence and freedom from air-bubbles was not confined to slides mounted by amateurs, but was a common fault in the preparations of some professional mounters, notable examples of such failures being handed round for inspection.

Among the chief causes of the presence of air-bubbles was either a want of perfect union between the cell and the slide, or imperfection in the mode of fixing the covering glass. This was seen in glass cells in a less degree, but more so in the various substitutes for glass of a more or less porous character. The same remark applied to the shallow cells made with cement, and the turntable; the cause of failure in each case arising from a want of union between the slide and the cell.

Another cause of failure was a want of flatness in the cell; in the case of glass and some other substances it was difficult to grind down to a flat surface, but with cells made of the materials they had used for years a perfectly flat surface could be easily obtained. There was one caution very necessary to beginners, and a neglect of which was a very fertile source of failure. Never hurry the operation in mounting. It was also well to allow the object to steep for some time in the fluid in which it was intended to preserve it. By this means the fluid penetrated into the object, and the after-presence of air-bubbles in the mounting was often avoided. In some cases steeping in alcohol, the application of gentle heat or the use of the air-pump was very advantageous, though the last-named might be dispensed with by allowing more time.

When the object was placed in the cell it was found advisable to heap up the fluid, and then to place the covering glass on it as horizontally as possible.

The making of deep and shallow cells, with modes of fixing them on the glass slides, and the different kinds of fluid best suited for different classes of objects, with the method of manipulation were practically shown by both gentlemen mounting different objects in deep and shallow cells, many hints being given at the same time on the preparation of cells and objects.

Information being asked for respecting mounting in Canada balsam, it was recommended that it be used as fluid as possible and cold. The process of boiling, as recommended in some manuals, being strongly condemned for most preparations. If time or very gentle heat were allowed any trace of air-bubbles would vanish. Attention was then drawn to a mode of mounting fresh animal tissue in balsam by steeping in absolute alcohol, by which means the water was absorbed, then in an essential oil, such as oil of Cassia, and lastly mounting in fluid balsam. Preparations were shown mounted in this way in which the time consumed, from cutting the object until the covering glass was placed over it, was not more than twenty minutes. The object had been placed on the glass slide, absolute alcohol had been added and drained off, this was twice repeated, then oil of Cassia, and lastly fluid balsam.

Very cordial thanks were given to Dr. Hallifax and Mr. Wonfor for a practical lesson, which lasted an hour and a half, and was evidently appreciated by a strong muster of the Microscopical Members.

NOVEMBER 13TH.

ORDINARY MEETING.—MR. E. A. PANKHURST ON "SOME OF THE RECENT DISCOVERIES RESPECTING THE VITAL POWER OF PLANTS."

There was great difficulty in determining "What is a plant," or to say where plant life ended and animal life began. If they affirmed that the power of independent motion distinguished the animal, then the coral, polyp, and many related species which had no more indepent motion than an oak, must be considered as plants, and the ciliated spores of plants which moved hither and thither in the field of the microscope must be considered as animals; and was the quick, rolling *Volvox Globator* less a plant, because it turned and moved.

Linnæus thought he had settled the question with his aphorism—

"minerals grow, plants grow and live, animals grow, live, and feel;" but as Dr. Carpenter remarked, "It is a very difficult problem to separate plants from animals by the simple distinction of feeling. The only idea we have of feeling in the lower animals arises from our attributing the same sensation to animals when they move as we experience ourselves." The tentacles of the sea anemones moved when they were touched, and so we said the sea anemone felt; the leaf of the sensitive plant moved when touched, the filaments of the barberry stamens fell down and struck the pistils when irritated—did they feel? The only criterion of feeling was movement in response to touch, and if this must be the test then many vegetable organisms, such as the sensitive plant, must be classed as animals.

The test of possessing a nervous system was an equally futile one. Some animals, like plants, had no semblance of a mouth or stomach, and received their food indiscriminately at any part of their surface. Fungi, too, demanded organic and not inorganic matter as pabulum, whilst the drosera or sun-dew of our English marshes, which had the faculty of entrapping insects, seemed to know what substances were worthy of being retained, as its glands did not close over pieces of wood which were put on the leaf, but a small piece of beef was at once caught and retained by the glands, and after some time the juices were extracted and it became colourless. These remarks applied with equal force to the sea anemone. Could they, on the face of the above experiments, refuse power of instinct to the strange animal plant of which he had been speaking?

It was well known, too, that those tissues of higher animals, which had the power of contracting when stimulated, viz., nerve and muscle developed voltaic currents, which had a certain direction in the tissues, and Dr. Burden Sanderson, of King's College, had lately discovered that these voltaic currents existed to a remarkable degree in the drosera and plants belonging to the same natural order.

It was further asserted that there were substances found in plants, which formed no part of the animal body. First, cellulose, the chief constituent of woody fibre, was declared to be distinctive of vegetable organisms; but this substance had been found in the human body. Next it was chlorophyl, that green colouring matter which gave plants their well-known hue, but Schultze enumerated eight species of animals—green animalcules—to which it gave their peculiar colour.

Dr. Carpenter alleged this as a distinction—"Where we find oxygen exhaled and carbonic acid given off we have an animal; and that where carbonic acid is absorbed and oxygen given out we have a plant." An elaborate series of experiments had, however, been lately made by Dr. J. C. Draper, of New York, and the conclusion he came to was, that "growth as applied to evolution of structure or organisation is inseparably connected with oxidation;" that was to say, that in the process of that cell-development whereby the structure of a vegetable organism was increased, carbonic acid was given off and oxygen inhaled, precisely the same as in animals. It was only the green parts that at any time exhaled oxygen, and then only under the influence of sunshine. The other parts of the plant above ground, which were not green, viz., the stem, twigs, flowers, &c., were at all times, day and night, exhaling carbonic acid. The whole history of the plant, from the time the seed was planted till its death, was a continual story of oxidation. Two distinct operations connected with the respiratory functions of plants must be distinguished. There was the preparation of this substance, out of which the cells were built and nourished. It was in this that the carbon was obtained from the carbonic acid, and oxygen exhaled. It was in this that the remarkable substance, chlorophyl, was intimately concerned.

The next inquiry was, by what power the functions of the vegetable organism were carried on? If they meant by these some special property which existed out of the animal or plant they raised up a kind of spectre, which was but the magnified image of their own ignorance. Forty years ago there was a hard and fast line between the inorganic and the organic—they could not build up in their laboratories the substances found in animal and vegetable organisms. The force which did this, to use Dr. Prant's words, "could not possibly be chemical; it was vital, and its nature was completely unknown." But now the chemist could prepare at least 1,000 substances precisely the same as those now formed within the living plant and animal.

Not only were organisms affected by light, heat, electricity, and magnetism, but plants, when placed under the different colours of the Solar Spectrum, were stimulated to the greatest activity under the yellow ray, which was the most luminous to the eye. In measuring the sum total of the vital energy of plants, scientific inquirers were at a great disadvantage; with man they could estimate the amount of nutriment imbibed, and could measure the work done, the weight lifted; they could ascertain the force with which the valves of the heart contracted, they could know the weight of blood raised by it; they could count the number of pulsations, and could ascertain the sum of the mechanical energy of existence—it equalled, one ton lifted 124ft. high every twenty-four hours. They had arrived at least at this position—in man and animals generally the power which the food supplied was expended from hour to hour; in plants the larger proportion of this power was laid by, was rendered latent as it were, was not actual but potential, so the sum total of the mechanical energy of a plant was difficult to calculate. There was no absolute distinction between plants and animals; every effort to make that distinction had failed and no doubt would fail.

After a vote of thanks, proposed by the President, Mr. J. E. Haselwood,

Mr. PIGGOT pointed out that it had been observed that cabbages grew more in windy than in quiet weather,—the supposed reason being that relays of carbonic acid were brought to them.

Mr. WONFOR considered they must not accept as proved some of the experiments made, as they were so startling that, until they had been confirmed, there was ground for reasonable doubt. The experiments with drosera were not new, but were made by Knight and others nearly thirty years ago.

Dr. HALLIFAX had heard nothing to upset the distinction between a plant and an animal, viz., a plant could assimilate inorganic matter. The food of an animal must have been elaborated by some vital principle before it could be assimilated. The case of fungi must be taken as an exception.

Dr. CORFE drew attention to the selective power of the roots of plants, and, in the course of his remarks, stated that he was trying a series of experiments in that direction, and would some day lay them before the Society. He felt almost inclined to describe what he had seen as approaching closely to instinct.

Previous to the reading of the paper, the receipt was announced for the Society's Herbarium, from Mr. G. DAVIES, of a very rare Lichen, *Verrucaria ochrostoma*, found that month by Mr. Davies in the Weald of Sussex. This lichen had been lost until then, not having been met with since Borrer first found it in Sussex in 1850. It was also mentioned that *Arthonia Spadicea*, new to Sussex, was found by Mr. Davies on December, 1872, in Ashdown Forest, near where *Calicium septatum* grows; and that he had found *Lecanora Hageni* with *L. sophodes*, var. *lecideoides*, near Cuckmere.

Mr. WONFOR reported that Mr. Willett had sent him, for examination, the second example of *lingula ovalis*, found at a depth of 294 feet, in the Sub-Wealden boring. It was believed that they had reached the Kinmeridge Clay, and some had thought they were nearing the Palæozoic rocks.

NOVEMBER 17TH.

MICROSCOPICAL MEETING.—MR. W. H. SMITH ON OPIUM ALKALOIDS.

Opium, whether derived from the white or black varieties of *Papaver Somniferum* was a very complex substance, consisting of one or two Acids and a number of Alkaloids. Morphine, Narcotine, Codeine Narceine, Meconine, Thebaine, Opianine, Papaverine, and Porphyroxine, had been long known, but Apomorphine, Chlorocodine, Codamine, Cotarnine, Cryptopine, Hydrocotarnine, Lanthopine, Laudanine, Laudanosine, Meconidine, and Protopine, were new Alkaloids but little known.

If a drop of a solution of Opium evaporated to the consistency of treacle be placed on a glass slide, and a thin glass cover be gently pressed down over it, crystals of the different alkaloids would be formed. While a solution of opium in weak spirit contained all the alkaloids known to possess medicinal properties, the different alkaloids were found to possess different properties. Thus, while crude opium was narcotic, narcotine, a very abundant alkaloid, was not a narcotic, but a tonic, similar in its action to quinine. Thebanine had a convulsive action, somewhat like the action of strychnine; apomorphine in doses of less than half a grain produced vomiting, without previous nausea, in ten or twelve minutes. The greater number though of the alkaloids possessed the narcotic principles of morphine in a less degree: thus, if the power of morphine was called 4, that of meconine and narcine would be 2½, codeine 1, cryptopine (a rare alkaloid) 5.

These facts had led to the use of various solutions of opium and its alkaloids, from which certain other alkaloids had been excluded. Some of these solutions, whose preparation was a secret, possessed peculiar virtues. If these preparations were evaporated on a glass slide, the microscope would reveal the peculiar crystals, so that the alkaloids being recognised the Pharmaceutist studying the solubilities of various alkaloids in different menstrua, might construct a formula which would produce a similar solution.

The per centages of the different alkaloids in Turkey Opium had been given as Morphine, 10·0; Narcotine, 6·0; Thebanine, ·15; Papaverine, 1·0; Meconine, ·01; Codeine, ·02; Narceine, ·02; Meconic Acid, 4·0; Thebolactic Acid, 1·25.

As about 10-11ths of the narcotic power of all the alkaloids was due to morphine alone, theoretically, 1 grain of morphine equalled 10 grains of crude opium, though practically this was not the case. Some considered there was a narcotic power in the uncrystallizable matter, and others that the alkaloids acted better when in combination with their natural acids. Very careful examination had shown morphine free and in combination with sulphuric and meconic acid; now as opium in its collection and preparation underwent rough treatment, and meconic acid was so unstable as to be decomposed by boiling water, the free morphine and sulphate of morphine might have been produced by the decomposition of meconate of morphine or a combination of morphine with some more unstable acid. A microscopic examination of fresh juice might solve the question.

Mr. GLAISYER having kindly procured him thebaine, papaverine, meconine, and sulphate of morphine, from which he had obtained very characteristic crystals, as well as from meconic acid, narcotine, morphine, codeine, and some of the preparations of opium, these would be exhibited under the microscope.

Narcotine, meconic acid, thebaine, and thick crystals of morphine were strongly affected by polarized light, while codeine, meconine, narceine, papaverine, and sulphate of morphine, were but slightly affected.

Narcotine and morphine both crystallised in prisms, the former polarized more strongly than the latter, and had pointed ends. Thebaine crystallised in very characteristic plates. Meconic acid in a very irregular manner, some of the crystals strongly resembling uric acid, but the typical shape appeared to be a square prism; codeine in octahedra, easily recognizable, or in prisms with pointed ends like those of narcotine, from which it was easily distinguished by its effect on the polarized ray; meconine in six sided prisms with dihedral summits; narceine in tufts of silky crystals, and sulphate of morphine in flat ended prisms, collected in tufts.

A discussion followed, in which Drs. Hallifax and Corfe, Messrs. W. H. Smith, Sewell, Payne, B. Lomax, and Wonfor took part; and after a vote of thanks to Mr. Smith, the Meeting became a Conversazione, when the preparations made by Mr. W. H. Smith were exhibited by the President (Mr. Haselwood), Messrs. Sewell, G. D. Sawyer, F. W. Sawyer, R. Glaisyer, W. H. Smith, and Wonfor.

DECEMBER 11TH.

ORDINARY MEETING.—MR. WONFOR ON THE BALANCE OF LIFE.

It was almost universally conceded that, with few exceptions, the plant obtained inorganic matter from the mineral world, and converted it into its own substance, and that the animal consumed the plant, appropriating to its own sustenance all the nutritious parts, and got rid of that which was useless, while the animal might itself, in turn serve as nutriment to another animal, by whom its parts would, more or less, be assimilated, and so on, until death and decay dissolved its frame, and returned its elements once more to what we termed the inorganic world.

It was true that to so general a principle there were some exceptions, in which the plant, instead of deriving its sustenance primarily from the inorganic world, utilized the elaborated juices of other plants, as in the case of the mistletoe, or derived its pabulum from either the decaying plant or animal, nay, in some cases, from the living plant or animal, as seen in the case of many fungi ; but these were exceptions to the rule by which we could trace the changes from the inorganic to the vegetable, and from the vegetable through the animal back to the inorganic world.

While tracing any of these changes, certain marked facts stood out, showing that, where inorganic matter had passed through organized bodies, and returned to the soil, the constituent elements had, as it were, acquired higher properties and had become elevated by passing through organized bodies.

Thus if a portion of bare rock was exposed to the action of light, heat, and moisture, in a short time a greenish colour was seen to come over it, which, if carefully examined, revealed the fact that spores of some cryptogamous plant had found a suitable *nidus* in which to germinate. Soon a moss or lichen made its appearance, to serve as food to some minute animals. Some portion of it decayed, the animal deposited its refuse matter, the wind caused particles of dust to settle and, in time, a small accumulation of soil was formed, in which the seed of a phœnogamous plant nestled and germinated, giving rise to a plant which could not have obtained either a foot-hold or an appropriate pabulum, on the mere rocky surface.

Or take what was so admirably shown some years since by Mr. Hollis in a paper on "Isomeric Substances." How different was the action, whether as manures or medicines, of many chemical compounds when derived directly from the inorganic world or indirectly from organic substances ; thus, while the chemist could detect no difference between some salts obtained from organic and inorganic matter, the plant on the one hand discriminated ; and on the other, the effect, when exhibited as medicines, was diametrically different. This was notably the case in certain preparations into which phosphate of lime entered —that prepared from bones being positive in its action ; while that derived from the Rock of Estramadura was negative. It would seem that when primitive elements, as they might be called, passed through organisms they became more elevated in their nature and properties.

Apart from these considerations, there was another law which seemed to run through plants and animals, viz., the provision made to keep down, or within limits, all tribes of plants and animals, so as to prevent, as it were, an extinction of some families or species through the overrunning of others.

There would be little difficulty in showing that, as far as the geological record revealed the facts, vast tribes of plants and animals had disappeared, to make way, it might almost be said, for higher and more developed forms, and, whether we accepted the conclusions of the evolutionists or not, the mass of life now was decidedly in advance of that of any other period of geologic time which preceded the existing Fauna or Flora. Of this it would be scarcely necessary to give examples, because to the most cursory observers the facts were patent.

If it were considered for one moment what would be the condition of things, if there were not agencies at work to keep down both plants and animals, we should possibly be startled by the calculations. Take for instance any one of our forest trees, which, like the sycamore, beech, or the oak, matured their tens of thousands of seeds annually—if there was nothing to keep them down, the land would in a few years be overgrown with these trees alone. Descending to smaller and less conspicuous plants, such as the groundsell, the shepherd's purse, or the chickweed, which seemed to produce several crops a-year,—in the course of but a few years, were there not some provision to check their progress, the whole land would be covered by them.

Take, among the animal creation, those pests to the gardener, the *Aphis* tribe. If the calculations be correct, one Aphis producing only 50 individuals for the first brood in the spring might be the fertile cause of so many individuals by autumn, that packed closely together her progeny would cover ten acres. Or assuming that the roe of a single codfish developed as many fish as there were ova, and so on for a few generations, but a short time would elapse before the sea would be full of codfish alone. Seeing these things did not occur, it might naturally be asked what agencies are at work to prevent such a catastrophe.

Both with animals and plants one agency by which they were kept down was this, they served as food to other animals, and when we sometimes unthinkingly asked what was the use of such and such creatures, the answer might not unfrequently be given—to preserve the balance of life.

In the balance of plant life, two very conspicuous agents played a part, viz., climate and soil. The former influence was possibly very slow; the latter acted more rapidly in checking the multiplication of individuals, while to these a third might be added, the smothering of seedlings by other and more vigorous plants. A curious illustration of this last was seen in the common maple, thousands of seedlings of which sprang up every year near the parent tree, and were killed by the smothering influence of the summer grasses.

Man for the purposes of cultivation disturbed the soil, either at home or in the colonies, and the result was, the spread of certain plants at the expense of the native plants. A curious fact had been observed by many—the greater abundance of annuals in cultivated, as compared with uncultivated countries, indirectly pointing to the fact that disturbed soil seemed necessary to their existence. Some had even gone so far as to assert that were the land in any populated country to be depopulated, the common wild "annuals" would become either very rare or extinct.

All must have noticed that when ground was disturbed, or a railway embankment made, plants such as the groundsell, shepherd's purse, poppies, speedwells, *poa annua*, and other annuals, make their appearance the first year, while sometimes the ground was covered with an *Equisetum*; the second year but few of these annuals were to be seen, their place being mainly occupied by biennials, such as coltsfoot, dandelions, and some umbellifers, which in time gave way to perennial grasses, docks, plantains, &c.

In America, wherever Europeans had put their foot, there Dutch clover had sprung up, while in South Africa, Australia, Tasmania, and New Zealand, the Scotch thistle, plantains, docks, &c., became noxious weeds, though the thistle had been found the best agent in breaking up the soil and rendering it fit for cultivation, owing to its roots penetrating so deeply.

One strange fact had been noticed—our European annuals in New Zealand proved themselves superior to the perennials of the country; thus, while few of the New Zealand indigenous plants were annuals, half the naturalized wild imports, to the number of 180, belonged to this class; while the dock, the sowthistle, and the white clover, were spreading everywhere, the latter displacing the native grasses, and the watercress was choking the streams, much in the same way as the American pond weed *Anacharis* was choking our English rivers. There did not seem the same vital force in plants imported from the Southern Hemisphere to the Northern, as from the Northern to the Southern ; some of our Northern plants, it was said, which seeded with us but once a year, or were only annuals, seeded frequently, or became biennials or perennials.

Buffon started the doctrine, that "taking beings generally, the total quantity of life is always the same," and "that man has made choice of some twenty species of birds and mammals, and these twenty species figure more largely in Nature, and are of more advantage to the world than all the others put together." Flourens, arguing from Buffon's *dicta*, has shewn that this tendency had always been observable—"relatively to the quantity of life, there is a kind of compensation upon the globe—in proportion as certain species die out the number of individuals in some others increases." And Darwin and his followers had shewn how, in the struggle for existence, the more powerful, and those best able to accommodate themselves to altered circumstances, survived, while the weaker and less yielding, had become extirpated.

Looking first at man and his selected mammals, and those animals which followed his footsteps, they had driven out, and were still driving out, the noxious and injurious animals, and replacing them with the useful. It was quite true that some of his companions did become pests. There was a Maori saying, "As the white man's rat has driven away the native rat, as the European fly drives away our own, and the clover kills our fern, so will the Maoris disappear before the white man himself"—a prophecy which it was feared, judging from the past history of the world, was too likely to be fulfilled. It was perfectly true that the Norwegian rat, which had nearly in our own island extirpated the black rat, had in parts of New Zealand extirpated the native rat, itself in many cases going out before the European mouse, while so patent was the disappearance of the native blue-bottle before the house-fly that colonists, knowing its usefulness, carried it with them in boxes or bottles to the inland stations. The pig, too, had become such a pest, that when 6d. a tail was offered, 22,000 tails were brought in from some runs without an apparent diminution in their numbers.

Descending to a still lower level, we saw how the balance of life was preserved by the agencies which tended to keep down what would in time become, and at times did become, pests. Few possibly realized, that while insects generally played an important part in the propagation of plants, by being the unconscious agents in perfecting the fertilization of flowers, they at the same time performed an important office in keeping down vegetation by eating the wood, the *alburnum*, or sapwood, the roots, the leaves, flowers, and seeds of plants, as well as removing what in the form of decaying and putrifying matter might become injurious. It was only when some especial ravage was performed that we realized their apparent destructiveness, as when the larvæ of beetles destroyed thousands of trees, locusts devastated a country, caterpillars laid waste the vegetable produce, or an *aphis* ruined our hops or grapes.

Birds were, as a rule, the agents in keeping down these pests, as those knew, only too well, by painful experience, where the birds, having been killed off, insects, destructive to their crops, abounded to an enormous extent. Other insects, themselves kept under by birds, preyed upon their fellow insects. Ichneumon flies deposited their eggs within the bodies of larvæ, which never became flies or beetles, able to propagate their race, while the larvæ of some species devoured the eggs and caterpillars alike, and so kept them in check. The aphides were devoured by the lady-birds, and their larvæ; by the larvæ of lace-wing flies, and those blue-black flies seen flitting about flowers, as well as being pierced by ichneumon flies.

He was partly induced to call attention to this matter by what was taking place in France. There some 87,000,000 acres of land covered with vineyards, producing on an average 1,100,000,000 gallons of wine a year, had, during the last eight years, been plagued by an insect pest, the *Phylloxera vastatrix* (closely allied to our well-known *aphis*, or green fly of the hothouse), which, during that time, had devastated 4,000,000 acres of French vineyards. Every possible device of the chemist had been tried in vain—carbolic acid, creosote, coal tar, petroleum, and naptha, with chloride of lime, sulphur, sulphide of lime, sulphurous acid, arsenious acid, and bisulphide of carbon, one of the most fetid of chemical substances, had each and all been used to no purpose.

It was true that some, notably the bisulphide of carbon, killed the pest, but it also killed the vines. Some suggested tobacco; this did succeed, but it was found that to strew the ground a foot deep round the plants with green tobacco leaves, took an acre of tobacco to save an acre of vineyard. Some said introduce small birds, but the pest was of so recent a date that the absence of small birds could not account for its spread.

At last, a French naturalist, M. Planchon, went to America, whence it was believed the *phylloxera* was imported, studied the insects and their enemies, and there found a nesting *acarus*, a species of American "plant lion," which lived upon it; and now, having introduced both the bane and the antidote, they were in hopes of checking the ravages of the *phylloxera.*

Here he might pause, the lesson learnt being that Nature preserved a balance if man let her alone; but if he interfered, and either killed off what he fancied noxious things, or imported pests, he would suffer detriment until either the antidote recovered strength on the one hand, or was imported on the other together with the pest.

The PRESIDENT, Mr. Haselwood, in proposing a vote of thanks to Mr. Wonfor for his paper remarked, apart from the interest and instruction afforded, Mr. Wonfor's paper shewed the importance of the right study of Natural History, and he would urge on all naturalists to use their best endeavours to extend the Society's roll of membership.

Mr. G. SCOTT would like to know from some of the chemists present, in reference to a statement made at the last meeting, that the chemists had been able to manufacture from inorganic material 1,000 substances identical with those said to be of purely vital origin, whether such was the case in the main?

Mr. W. H. SMITH shewed that the chemist had been able to produce certain substances, such as essences and dyes, but that most of them had some organic source.

Mr. HENNAH pointed out that the oil of lemon had been manufactured by the chemist from inorganic substances; but Mr. T. W. Wonfor subsequently asked from what substances that oil had been manufactured, and Mr. Hennah replied from turpentine.

Mr. WONFOR then argued that in every case an organic substances was taken as the basis on which the artificial essences, &c., were built up.

Dr. **CORFE** pointed out that plants disseminated between organic and inorganic manures; and in the case of parasites, they were only found where degeneration of tissues had commenced.

Mr. G. **SCOTT** enquired how the appearance of plants on embankments and broken ground, without, so far as had been observed, previous sowing of seeds, could be explained.

Mr. **WONFOR** considered that the seeds were conveyed together with the earth, or brought to the surface, and so were able to germinate. It was a well known fact that different seeds possessed different degrees of vitality, some germinating only after a few months, while some retained their vitality for centuries.

A discussion was carried on for some time by Messrs. W. **SAUNDERS**, **WONFOR**, and **HENNAH**, on the greater vitality of weeds and seeds of the Northern or the Southern Hemisphere, the last named gentleman promising to make enquiries respecting the times of flowering and seeding of European plants introduced into New Zealand.

Previous to the reading of the paper, a pleasing reminiscence of the Society's Excursion in 1872, in the form of a painting representing a scene on the Adur, was presented for the Society's Album by Mr. O'Bryen Lomax.

JANUARY 28TH.

ORDINARY MEETING.—MR. J. C. WARD, F.G.S., ON THE OLD GLACIERS OF CUMBERLAND.

The general characters of modern glaciers were as follows:—

A glacier represented the snow drainage of a mountainous tract, and was a river of ice moving in all respects like an ordinary river, only much more slowly. It flowed faster at its centre than at its sides, and at its upper surface than at its lower; it became troubled on rounding a curve, and broken up in falling over a precipitous part of its bed. The line of swiftest motion changed from side to side with the curvature of the valley, as in the case of a river; and regelation constantly re-united the shattered portions on changing from a troubled to a smooth part of its course.

Rocky fragments were for ever falling from the mountain sides upon the glacier, where they formed long lines of débris—*lateral* *moraines.* When several glaciers united, some of their lateral moraines became confluent and formed *central* moraines upon the surface of the compound glacier. The ice, ever moving on, at last reached a point where the melting power of the sun's heat equalled the forward movement, and here the vast quantities of stony material carried along in the ice were thrown off and formed a great semi-circular mound called a *terminal* moraine.

As the ice was pressed down the valley, it rounded, smoothed, and scratched the rocks, by the aid of stones imprisoned between it and the rocky sides and bed. Oftentimes, sinking in height, it left blocks perched in strange-looking positions, into which they could not have fallen.

Where the ice was squeezed through a narrow gorge, its velocity was increased and its power of rocky abrasion likewise. Altogether, glaciers not only brought down vast quantities of rocky material from higher to lower levels, but they also deepened and abraded the valleys through which they flowed, producing greater effect at certain points, where the pressure of the ice was greatest, or the rocks were softest, than at others. The marks and effects of glacier action were perfectly distinctive, unlike those produced by any other natural agent.

When glaciers terminated in the sea, their ends broke off and formed icebergs, which floated away with the moraine material upon them, and scattered it over the sea-bed in melting.

Among the Cumbrian mountains the signs of glacier action at a recent period were everywhere plainly visible. Rocks were rounded, smoothed, and striated; huge blocks lay perched in strange positions; many an upland valley was filled with old terminal moraines.

The sequence of events during the so-called Glacial Period was probably much as follows :—

1. Glaciers, small at first, gradually increased in size as the climate became more severe, and kept pushing before them or partly overriding their first-formed moraines.

2. The separate glaciers became united into a more or less continuous sheet, clothing the mountainous country in one uniform icy mantle.

3. The climate ameliorating, the ice-sheet diminished, shrank into separate glaciers once more, and each glacier as it became smaller left moraine after moraine behind it, until when the ice had all disappeared, the country was covered with mounds of moraine material much broken into and re-sorted by the swollen streams and rivers flowing from the ends of the fast-melting glaciers.

4. Then a subsidence of the land ensued beneath the sea; the moraine matter was remodelled and partly rounded beneath the waves and currents; and banks of sand and gravel were formed at certain points, where currents met.

5. When the land had sunk some 800 and 1,000 feet beneath its present level, the cold conditions began to return, and floating ice swept through the various straits, which now are valleys parting one mountain range from another.

6. The subsidence continued, until probably merely the mountain tops were above water, and then as slowly was the land once more upheaved, and small glaciers occupied the mountain hollows.

7. Finally, the relative level of sea and land became pretty much what it is now, and the second set of glaciers, which, although large, had never attained to the size of the first, dwindled away, and left the very perfect moraines now to be found at the head of many of the upland valleys.

8. An early race of men, making *polished* stone-implements from the rocks of Scawfell, then inhabited the district, and saw perhaps the last of the Cumberland glaciers. This early race, by no means the earliest which England had seen, was succeeded by others to whom the use of metals was known, and the conquering Roman legions also left their mark on mountain top and valley bottom, which a short age before was covered with snow and ice.

The lakes of the district lay in *rock basins*, or hollows scooped out of the solid rock. The rocky sides of these basins were often smoothed and scratched, and it was certain that the hollows had been filled with glacier ice.

It was difficult to see how such hollows could have been formed either by mere weather-action, by running water, by the sea, by special depression, by rock-disturbance, or the formation of gaping fissures. Could the onward movement of the glacier ice have scooped out these shallow basins? (Ramsay).

The following points were in favour of such a solution to the question. The depth of the lakes was very slight as compared with the thickness of glacier-ice which pressed down the valleys. The deepest parts of the lakes were precisely at those points at which, from the confluence of several ice-streams or the narrowing of the valley, the onward pressure of the ice must have been greatest.

In the case of such lakes as Derwentwater and Bassenthwaite, the ice had produced a long and shallow groove along the bed of a flat-bottomed pan-shaped valley. In the case of such as Buttermere and Crummock-water, it was a round-bottomed valley that had been deepened. Hence the reason, probably, why the latter lakes were deeper than the former.

Since the formation of these rock-basins they had been greatly filled up by sediment and gravel brought down by the streams and rivers from the hills around. In several cases one originally long lake—such as Derwentwater and Bassenthwaite united, or Buttermere and Crummock—had been filled up in the middle in this way, and thus two separate lakes had arisen.

After a cordial vote of thanks, proposed in eulogistic terms by the PRESIDENT (Mr. Haselwood),

Mr. G. SCOTT inquired if there were any shells among the beds of sand and gravel referred to?

Mr. WARD replied that none had yet been found; but when they considered that there were many such deposits in Wales, which had been thoroughly examined, and only in one instance successfully, it was not to be wondered at that he, by a slight examination of those in Cumberland, had not found any shells.

Mr. E. PANKHURST asked what was the greatest height at which there were any signs of glacier action among the Cumberland Hills? He knew that the idea that the Lake of Geneva had been hollowed out by ice had considerably staggered a great number of geologists.

Mr. **Ward** said that the greatest height was rather more than 2,500 feet.

Mr. **Scott** thought they must indicate how well pleased they were to again see Mr. Ward. It was refreshing to have that gentleman away from his mountains, although at the same time tantalising to have to stop in Brighton while he was ranging among the hills. Mr. Ward had ingeniously tried to make them believe that a great deal of the information he had laid before them was old, that much of it had been brought forward elsewhere. That might be true, but they must recollect the great share Mr. Ward himself had in bringing it forward. What he had told them that night truly showed the immense importance of the Geological Survey. It gave a good idea of the work the members of it were carrying out, and the part Mr. Ward was taking in it. When they considered the extraordinary geological changes going on upon the earth's surface, the reconstruction, in fact, of the globe, by the transportation and deposition in ice of dirt and boulders, they were overwhelmed. A wide subject rose out of the lecture that night, namely, what brought about these glacial epochs? but that they might at a future time consider. They could not, however, separate without again manifesting their gratitude to Mr. Ward for his excellent lecture.

Mr. **Ward**, in returning thanks, remarked that he should scarcely be worthy of his salt, if he could go over those mountains in the prosecuion of his geological work and not see the things he had seen. Therefore, he did not think that any credit was due to him for making the observations he had; but that he would have deserved a deal of blame if he had not made them.

JANUARY 23RD.

SPECIAL MEETING.—CHANGE OF ROOM.

The President, Mr. J. E. **Haselwood**, explained the object of the meeting—to receive and consider a recommendation of the Committee to the effect, that the offer of the Town Council of Brighton to the Society, of the use of the Curator's Room, at the New Free Library, for accommodation for the books and meetings, be accepted. The question was a rather important one, not that he supposed there would be any difference of opinion in deciding it, but because the Committee had felt it was beyond their power to decide; and hence the calling of them together that night. He would, however, call on Mr. T. W. Wonfor to name the reasons upon which the recommendation was made.

Mr. T. W. WONFOR, one of the Hon. Secretaries, stated that in October, 1872, a letter was directed from the Society to the Pavilion Committee of the Town Council, inquiring whether the Society could be accommodated with a room at the new Free Library and Museum, in which to hold it meetings and place its books, and upon what terms? In reply, a letter, dated the 8th January, 1874, had been received, delay, they had heard, being occasioned by the deferring the consideration of their application till the Library had been rendered favourable to their admission, should that have been contemplated. The following was the answer to their communication :—

"Brighton, Town Hall, 8th Jan., 1874.

"DEAR SIR,—Referring to the application of the Brighton Natural History Society, for accommodation for their library of books and for the meetings of the Society at the New Free Library recently erected by the Corporation, I am instructed by the Town Council to offer to the Society the use of the Curator's Room for their fortnightly meetings, and for placing therein bookcases and contents, upon the condition that the books shall be under the charge of the Curator, and be available for reference by the public in the same way as the other works in the Free Library, but reserving to members of the Society their right as at present of borrowing any of the books so to be deposited.

I am, dear Sir, yours faithfully,
"DAVID BLACK.

"J. C. Onions, Esq., Secretary,
"Brighton and Sussex Natural History Society."

In reply to the above, the Committee had resolved to inform the Town Clerk that the Society accepted the offer on the terms specified, and, at the same time, requested him to be good enough to convey to the Town Council their thanks for the way in which they had responded to their request. The Committee, however, felt that they could not carry this resolution into effect without the sanction of a general meeting of the members; and he should propose that this sanction be given. If the proposition were carried, he should feel that what little labour he had given to the Society in the past had not been thrown away, but been usefully bestowed; for by accepting the offer of the Town Council they would acquire a status in Brighton which they had not hitherto occupied, and which no other Society had ever occupied, namely a public recognition by the authorities.

There were sundry reasons why they should accept the offer. The room suggested for their use would afford them more than double the space they had at the present time. In the room in which they were met not many more than thirty persons could be comfortably seated; in the Curator's Room at the Library, above one hundred could be similarly accommodated. Then their library, which had been increasing so enormously, in the hands of their kind friend, Mr. Gwatkin, would also find a place at the Museum; and this was of great moment, for it was but a question of time when their library would outgrow the capacity of Mr. Gwatkin's territory, and require to be removed, and this could not be done under more advantageous circumstances than the present. It would be taken in charge by the representative of the town authorities in the person of the Curator, and, though their books might not be more secure, yet the members having them out would be more strictly looked after.

Another great convenience would be afforded by the use of the reading-room, particularly in the case of those who felt a delicacy in turning Mr. Gwatkin's territory into a reference-room. Some might urge that the books, when taken out by indiscriminate readers, would possibly get more or less damaged; but to that objection he would say, that the books were not allowed to go out of the Library except in the possession of members of the Society, and the town officials, he knew, looked very sharply after their own books, and they would look with equal sharpness after the Society's. One other consequence might be, that the books, being only available for reading by non-members in the rooms, many would be induced to join the Society that they might be enabled to take the books home with them.

Again, it might be urged that the Society had not yet been at any cost for book cases, and that a considerable expense would have to be encountered for such. Well, that would be a necessary expense, and the Society was quite able to sustain it, and the Committee would see that suitable and proper cases were procured. He was reminded by Mr. G. Scott that it was understood by him that, if their meetings should be so large as to overflow the accommodation of the Curator's Room, the lecture-room upstairs would be at their disposal. Another advantage would be, the facility provided for examining specimens in illustration of any lecture delivered. Letters had been received from several members, unable to attend the meeting, approving of the proposal. Mr. Henry Willett, whose consent to the removal was necessary, inasmuch as several of the books were his property, had also written expressing not only his entire approval of the suggestion, but also his wish that his books should go to the Town Library anyway, but, if the Society were to remove, that they should remain in their library, which would be added to by him. He moved that the recommendation of the Committee be approved and accepted, and that a letter be written to the Town Clerk.

Mr. G. D. SAWYER seconded. He endorsed all that Mr. Wonfor had said.

Mr. SAUNDERS inquired if they had any guarantee that the books, &c., should remain the property of this Society.

Mr. JOHN COLBATCH ONIONS, the other Honorary Secretary, replied that the Town Clerk had written that the books were simply to be deposited, and in one of their communications they had stated that it was, of course, understood that the books and bookcases would remain the property of the Society.

Mr. SAUNDERS said that he was quite satisfied.

Mr. J. DENNANT thought the change of locale would be of immense advantage to the Society: it would thereby become much more influential, and would most likely draw more young men into its ranks than hitherto.

Mr. GWATKIN, the present Librarian, expressed his concurrence in the proposal to remove their library, chiefly on account of the rapid increase in the number of books it contained. He had done his best with them, and trusted he had given satisfaction (hear, hear, and applause), but the baby had grown, and was growing, very large. (Applause.)

The motion was then carried unanimously.

Mr. T. W. WONFOR, feeling that they would not have occupied the position they were in had it not been for the kindness of the Medico-Chirurgical Society and the Dispensary Committee, moved that a letter be written by the Secretaries, as soon as they removed, conveying the best thanks of the meeting to that Society and that Committee for having granted them the use of the rooms for so many years.

Mr. G. SCOTT seconded, that he might have the opportunity of saying how extremely he was pleased and gratified by the unanimity in which this matter had been settled. The Library Sub-Committee, the Pavilion Committee, the Town Council, their own Committee, and the meeting that night had all acted unanimously in the matter. He knew they would all look back on the evenings spent in the old room with feelings of pride, gratification, and gratitude,—gratitude for the kind attention bestowed on them by Mr. Robert Glaisyer ; and when they pitched their tent on a new camping ground, he could promise them a cordial welcome ; and he hoped they would have many happy evenings there also.

This motion was also adopted.

Mr. W. SAUNDERS, seeing there was a large attendance of members, proposed a vote of thanks to Mr. Gwatkin, the Librarian, for the kindness and diligence with which he had filled that post for many years.

Mr. SIMONDS seconded ; and the proposition having been carried amid applause,

Mr. GWATKIN returned thanks.

Mr. JOHN COLBATCH ONIONS, in highly complimentary terms, proposed a vote of thanks to Mr. Robert Glaisyer, for granting them the use of his rooms and assisting them in various ways.

Mr. T. W. WONFOR seconded, and remarked that the general aid Mr. Robert Glaisyer had given them entitled him to be called a third Secretary, an extra Treasurer, and occasionally the Committee itself.

The CHAIRMAN also alluded to Mr. Robert Glaisyer's invaluable services.

All hands having been held up for the motion,

Mr. ROBERT GLAISYER expressed his gratitude.

The following letter, in accordance with the resolution of the meeting, was sent to the Town Clerk :—

(COPY.)

"56, Middle Street, Brighton,
"27th January, 1874.

" DEAR SIR, -We are in receipt of your letter of the 8th instant, in which you state that, in answer to the application of the Brighton and Sussex Natural History Society, you are instructed by the Town Council to offer to the Society the use of the Curator's Room at the New Free Library for their fortnightly meetings, and for placing therein book cases and contents upon the condition that the books shall be under the charge of the Curator, and be available for reference by the public in the same way as the other works in the Free Library, but reserving to members of the Society their right as at present of borrowing any of the books so to be deposited. In reply thereto, we beg to inform you that we are instructed by the Committee of Management of the Society to accept the offer upon the above terms, and, at the same time, to request you to be good enough to convey to the Town Council the thanks of the Society for the manner in which their application has been responded to.

" It is, of course, understood that the books and book-cases will still remain the property of the Society.

" We are, dear Sir,
" Yours truly,
"T. W. WONFOR,
"JNO. COLBATCH ONIONS, } Hon. Secs.

"The Town Clerk of Brighton."

JANUARY 22ND.

MICROSCOPICAL MEETING.—MOUNTING IN GLYCERINE JELLY, PRACTICALLY ILLUSTRATED BY MR. T. W. WONFOR.

While Canada Balsam was one of the best *media*, as far as permanence and ease of working were concerned, it possessed the disadvantage that all objects, and especially fresh preparations, or those containing water, could not be mounted in it, though, in many cases, steeping some objects in absolute alcohol deprived them of the water and enabled the microscopist to mount them in Balsam.

Glycerine, from its well-known preservative qualities, had been recommended as a medium; one caution, though, must be borne in mind: substances containing lime would be spoilt, as had been pointed out by Dr. Carpenter, who, employing glycerine to preserve pentacrinoid larvæ of Comatula, found that the calcareous skeletons were dissolved and the specimens spoilt.

As a preservative medium, glycerine could be used alone, diluted with two parts of camphor water, with equal parts of gum arabic and water, and a small quantity of arsenious or carbolic acid; or, what he had found worked admirably with many objects, glycerine jelly.

The manuals on the microscope gave instructions how to prepare glycerine jelly; but, as it could be purchased ready prepared,—and a small bottle would last years,—he would advise those who wished to try it to obtain either Rimmington's or Aylward's, both of which he had tried and liked. The former contained creosote, itself a good preservative, while the latter liquefied more readily, sometimes an advantage.

For some delicate preparations he had found either could be diluted with water. He had also tried the glycerine jelly, sold by the chemists for chapped hands; but this required to be filtered before being used.

Whichever form was employed, the gentle heat of a fire, lamp, or, best of all, of warm water, was required to liquefy the jelly, which could be applied in different ways. One method was to place a drop on each of several slides and let them cool; then gently warming them the film at the top could be removed, thus carrying away air bubbles, or, while warm, the object could be immersed in the drop of jelly; or the object might be placed on the slide, and as much of the moisture as possible being removed by blotting paper, the jelly might be dropped on it or placed by it, to run in of its own accord.

The covering glass, previously warmed (best by dipping in warm water), might be dropped on and gently pressed down and allowed to cool, when the superfluous jelly being cleared away, a ring of varnish could be run round, and the slide would be ready for the cabinet. It should be mentioned that the objects to be mounted should previously have been placed in water or diluted glycerine.

One caution should be observed, viz., slide, jelly, covering glass, and objects, should all be raised to the same temperature ; if this was done air-bubbles would be avoided. As proof of this assertion, the processes described were gone through and objects mounted in each way without air-bubbles.

Dr. HALLIFAX, in reply to an enquiry, illustrated his method of mounting in diluted glycerine in cells, and exhibited a simple method for making oval cells, as well as a very ingenious contrivance by which thin sections of minute objects could be arranged while floating in fluid, in the centre of a glass slide, without disturbing or distorting the parts.

The President, Mr. HASELWOOD, exhibited a new form of section-cutting instrument, recently described in the *Monthly Microscopical Journal*, and having a glass plate and a receptacle for ice, or a freezing solution when cutting thin sections, &c.

FEBRUARY 26TH.

ANNUAL SOIREE.

The Third Annual Soirée was held at the Royal Pavilion.

The Rooms used on the occasion were the Banqueting Room, the Saloon, South Drawing Room, South Lobby, and Corridor. The chief feature of the evening was a display of Scientific Instruments. The Microscopes, which numbered about fifty, were contributed by the Rev. J. H. Cross, M.A., Rev. Mr. Payne, Drs. Badcock, Hallifax, Massy, and Taaffe, and Messrs. S. Aylen, Ardley, Baker (Holborn), Cooper, Capon, J. Curties, D'Alquen, J. Dennant, Gwatkin, T. Glaisyer, T. H. Hennah, J. E. Haselwood, Henry Lee, B. Lomax, Mitchell, G. Nash, W. Puttick, F. W. Payne, Ridge, J. J. Sewell, W. D. Savage, C. P. Smith, G. D. Sawyer, H. Saunders, G. T. Shaft, W. H. Smith, T. W. Wonfor, Wonfor, jun., and F. E. Sawyer.

Telegraphy and the application of electrical instruments was admirably shown by the Post Office authorities. Application having been made to Mr. Scudamore for the loan of instruments, the request was at once granted, and Mr. Sievewright, M.A., was appointed to superintend their exhibition. Mr. C. J. Whiting, the Brighton Post Master, also accorded the project his warm approval; and a staff of energetic, obliging, and painstaking clerks from the head office on the Old Steine were present to assist in the working, under the superintendence of Mr. G. Field. Numerous and varied were the messages sent from one end of the room to the other during the evening. One of the most compact and wonderful of all the telegraphic instruments appeared to be that by which messages are sent and received solely by sound, no other means of indication being afforded. This instrument required a skilful and attentive operator, but the practised ear seemed to overcome the apparent difficulty and transcribe the message with the greatest ease and facility. Telegraphy as applied to railway signalling was also shown.

An automatic spectroscope, constructed by himself, was shown by Mr. H. Pratt; amicro-spectroscope by Mr. Mitchell. In the Saloon Mr. F. E. Sawyer arranged an exhibition of meteorological instruments, charts, and diagrams, including a self-registering rain gauge, invented by Mr. E. Rowley.

Galvanic batteries were exhibited by Dr. Badcock, and Messrs. J. J. Sewell and B. Lomax; fine equatorial by Mr. D'Alquen; kaleidoscopes by Messrs. G. Nash and Haselwood; graphoscopes by Messrs. Rowsell and Treacher.

In the Corridor there was exhibited a magic lantern at intervals during the evening. The slides were chiefly natural history objects, lent by Mr. C. Baker, of Holborn. They were exhibited by Mr. G. Nash, and explained and remarked upon by Mr. T. W. Wonfor.

In the Saloon, South Drawing Room, Corridor, and Banqueting Room were also arranged various objects of Natural History and Archæology, the most noteworthy being:—Very fine carpological collection, consisting of some hundreds of fruits, about sixty specimens of Canadian woods, and a collection of Japanese plants, in pots, by Mr. Hemsley; two brass Persian lavers, about 400 years old, from a Persian temple, candlestick, lamp, and coffee pot, all exquisitely engraved, and five cases of Indian moths and butterflies, by Mr. Wills; nine cases of English moths and butterflies, chiefly taken in Sussex, by Mr. Wonfor, jun.; four photographs of the same group of beech trees taken at the four seasons, and several tropical plants in pots, by

Mr. T. H. Hennah; vegetable hygroscope and micro-photographs of microscopic objects, by Dr. Hallifax; skeleton leaves and fruits, very beautifully preserved, by Mr. Gwatkin; a fine collection of Sussex lichens, by Mr. C. P. Smith; collection of minerals illustrative of iron and its combinations, by Mr. Pankhurst; coral, model of Parish Church, by Mr. J. J. Sewell; fine collection of shells, by Mr. R. Glaisyer; models of anchors and ship, by Mr. H. Vaughan; specimen of Sussex marble, by Dr. Corfe; conglomerate shells (from raised beach of St. Augustine, U.S.), by Mr. Warren, of New York; medallion of Ceres, made of compressed sawdust, by Mr. Tatham; a drinking fountain of unburnt clay, modelled and made at Ditchling, of Sussex clay, by Mr. Johnson.

One feature of the evening was the delivery of several short addresses, at intervals of about half-an-hour.

The PRESIDENT of the Society (Mr. J. E. Haselwood) made a few introductory remarks. Having, on behalf of the Natural History Society, given the company a cordial welcome to the Soirée, he alluded to the fact of the Society having recently changed its place of meeting from the Dispensary to the Free Library and Museum. The arrangement had been effected in the most satisfactory manner, the Town Council, with great courtesy and kindness, allowing them the use of one of the rooms, in consideration of which the Society had agreed to place their valuable library at the service of the public. (Applause.) Of late years, the Society had largely increased and he was yet of opinion that 160 or 180 members were not enough for a town like Brighton. He hoped, however, that the change of *locale* would have the effect of increasing their numbers. They not only wanted men of scientific attainments, whom they would be most pleased to welcome; but young men, who desired to improve themselves, and men of business who were able to spare the time. He could promise such that they would find the instruction which the meetings of the Society afforded blended with amusement.

MR. G. SCOTT ON "THE ELK."

Every visitor to the Brighton Museum must have been struck with the noble pair of antlers which were suspended at the southern end, for the possession of which the town was indebted to Sir Cordy Burrows. They were the antlers of the *Megaceros hibernicus*, or extinct Irish elk, the remains of which were now found in the morasses of that country. Their gigantic size would be seen when he stated that their antlers were something like 12ft. in width, and reached upwards of 10ft. from the ground. Perfect skeletons of the elk were now to be found in the British Museum and other places. The position in which their bones were discovered evidently showed that the noble creatures were driven into the lakes, and must have perished there. In an early poem relating to a hunt in the 12th century, the "scealch" was referred to, and this by some was thought to mean the elk; he, however, was disposed to think it meant the seal, which is still designated by many Scotch fishermen by that name. Passing from the extinct species to the living *(Alces malchis)*, as they are to be seen in North America, and North Europe, and Asia, the thanks of the town were due to Mr. H. Willett for having presented to the Museum a pair of moose antlers. The pair before him (which had never before been publicly exhibited) weighed 27lbs.; but a full grown pair would weigh double that. It was said that the black elk used its antlers for shovelling away the snow. He should like this to be true, but the probability was, he thought, that it was not. Of late, much had been said about the development of man, and that when he made his first appearance on the earth he was a poor degraded useless creature. But if he were so, Nature certainly made a great mistake in development; for he would want all his wits about him to deal with such creatures as the extinct elk, the gigantic hyena, the cave bear, the lions, tigers, and other animals which abounded at that time. (Applause.)

MR. T. W. WONFOR ON "SPONGES."

Over few natural objects had there been such differences of opinion among naturalists as over sponges. At one time believed to be produced from the froth of the sea; at another to be neither plant nor animals, though partaking of the nature of both; then claimed as inanimate objects possessing some kind of life; then deemed fungi or algæ; then zoophytes or plant animals; and last, in the estimation of most naturalists, they had settled down into undoubted animals, technically called *poriferi* or pore-bearers, from the circumstance of their surfaces being covered all over with pores or openings.

The sponge of commerce was not the animal, but only a part of the animal structure, the skeleton, according to the nature of which sponges were roughly classified into *keratose* or horny, *siliceous* or flinty, and *calcareous* or limy sponges. The forms with which we were most familiar were the horny, the skeletons of which were found so useful and were of great commercial value. Among some of the most striking of the flinty sponges were the exquisite Venus' flower basket, the sea-bird's nest, and the glass rope, the last-named for some time a bone of contention among naturalists, until the whole sponge was obtained. Most sponges might be said to consist of three distinct parts; the skeleton, the living part, and the spicules. The living part, called *sarcode*, was a glairy gelatinous substance about the same consistence as the white of an egg, of different colours, and composed of a granular substance similar to that simple organism, the Amæba, which in the living sponge enveloped and permeated the whole structure; portions of it were ciliated, and by means of these ciliæ, a circulation was kept up. This living sarcode secreted from its food material for re-formation, building up the skeleton and the formation of the bodies called spicules.

The spicules were composed either of silex or lime, and either formed, as it were, supports to the skeleton, or, as in the case of some of the siliceous sponges, served as a means of anchoring the animal. Microscopically considered, the spicules presented a very varied and beautiful series of objects of every conceivable combination of needle-like bodies, and would seem in many, if not all, to be not only invested but penetrated by the sarcode. In the siliceous sponges, and especially the anchoring ones, they were built up of successive layers of deposit, a fractured end presenting an appearance similar to a series of tubes as seen in a telescope.

The holes or pores in the skeleton were of two kinds—those which took in currents of water, and those larger ones called *oseula*, from which currents containing effete matter were ejected. So great was the reparative power among sponges that if, as had been proved by experiments by Bowerbank, a living sponge be cut in half and the parts brought together under water, in 24 hours all trace of cutting would be effaced; nay, if a piece were cut out of a living sponge and inverted so that opposite surfaces were brought together, in twenty-four hours all trace of cicatrix would be gone. This rapid and marvellous healing was accomplished by the jelly like mass. Several small bodies were at times found at the base of sponges and were ejected from the sponge itself; these were the gemmules, which afterwards become sponges.

In the Museum might be seen specimens of British and foreign sponges, chiefly of the keratose division, a beautiful specimen of the sea-bird's nest, presented by Captain Marshall Hall, by whom in the Norna expedition it was first dredged, as well as a capital example of the Venus' flower basket, deprived of all but its siliceous skeleton. There, too, might be found fossil sponges, notably those strange and till recently unclassed objects, called choantes, together with ventriculites from our chalk. During the chalk era sponges must have been very abundant, as proved by our flints; for scarcely a chip or flake could be made, without sponge or sponge spicules being traced. In the Aquarium might been seen living sponges, not so conspicuous as the Turkey and honeycombed sponges of the Mediterranean, but more interesting, because their growth and movements could be watched. One thing the Aquarium had done; if he were wrong his friend, Mr. Henry Lee, whom he saw present, would set him right, it had given a sponge new to science. (Hear, hear.) This was but one of the advantages science was deriving from the Aquarium. Under the microscope an opportunity would be given for any who wished to see portions of sponges, spicules, aud gemmules.

MR. BENJAMIN LOMAX ON A "GREY PEA."

As his lecture must necessarily be a small one, he had chosen a small subject—a grey pea, the missile of the schoolboy—the music of the boy's rattle—the apparatus of the thimble-rig man—and yet one of God's choicest works. Dry, hard, yellow, wrinkled, it looked different indeed from the full green seed, borne on a graceful twining plant, whose flowers gardeners had not disdained to cultivate, and whose scent perfumers had thought worth extracting. Yet, even in its corpsehood, it boasted a great commercial value. By thousands, by tons, by shiploads, peas passed through the markets, and travelled across all seas to every land. A vast acreage of green England belonged to the fairy "Peablossom." A good pea harvest meant prosperity, plenty, wealth to the few, and work for the many. A failure in the pea crop was poverty, desolation, ruin. And no wonder, for the pea was the chosen food of ancient and modern, of rich and poor, of man and beast.

On some plant of the pea kind Daniel and his companions lived, when their glorious Hebrew faces out-matched the flower of Persia. On peas poor Monmouth tried to feed, when the bloodhounds were on his trail. The nobleman gave a labourers' annual house rent for green peas at Christmas, and the beggar asked for pea soup at the Workhouse. Peas formed a large element of the Navy's food, and *they* nerved the arms that fought at Copenhagen and Trafalgar. Well might they do so, for in this little globe was contained a larger amount of *flesh* than in a similar bulk of "The roast beef of old England." Art could not compose, Nature had not produced, so much food in so little compass as in this pea, and its relation the bean. But what was it that we gobbled so recklessly? What, indeed! This seed contained a study too long for human life, a secret too deep for human science. There was a *life* within this pea. If he struck it with a hammer it separated in two halves, just as Moore's "heart indignant broke to show," in a truly Irish manner, "that still it lived." This pea split its sides from pride of birth, proving itself thereby one of the great family of double-seeded plants, not a connection of the downtrodden grass or awkward cactus, but a relation of the forest trees and the British oak itself. And no mean relation, for there were peas in America which bore pods a yard long, and twisted round large trees till they strangled them.

If this little seed were placed in the warm ground, and the dews of heaven were allowed to fall upon it, the skin that covered it would draw aside as gently as ever mother drew a counterpane off her sleeping infant; the two lobes would open, and two marvellous intelligences would pursue their way—one upwards, one downwards; one armed with a point shaped like a lady's thimble, hard and pointed as a lady's needle, flexible and thin as a lady's thread, and sensitive as a lady's finger, pushing its way through the hardest clods; and one green and beautiful, throwing out slender leaves, and taking hold with tendril fingers of some dry old stick, henceforth a thing of beauty, glorious with foliage, and flowers, and sweet perfume. The flower died, but in it grew up first a tiny pod, which swelled at last to a receptacle of peas like this—like this, a common vegetable, yet, he trusted, no unworthy subject of a ten minutes' lecture.

MR. E. A. PANKHURST ON THE CAÑONS OF THE COLORADO.

At their Soirée last year Mr. Lomax illustrated the meaning of his statement, that the most useful lesson the microscope could teach them was to use their own eyes microscopically, by directing attention to the little channels which tiny streams dug, the sediment they carried along with them, and with which they half-filled up the tiny pool that marked the end of its course. That subject he now wanted to carry further. Magnify that stream a few thousand, perhaps million, times, and they had still the same forces at work, acting in precisely the same manner ; but now the channel of the rivulet had become a huge ravine, and they had a vast torrent carrying on to the sea the dust and the *débris* of a range of mountains. From an imaginary sketch of such a reality he directed attention to an actual one suspended on the wall behind the platform. It represented the course of a river through a table land of Spain near Parrulena to the north-west of the Sierra Nevada, where for miles it flowed at the bottom of an abyss of hard rock, not rubbly chalk, which it had itself scooped out to the depth of two hundred feet or more. Lateral streams running into this chasm, or cañon, as it is termed, had cut down portions of its sides until hills had been thereby formed. But he wanted them, with the assistance of another diagram, to carry their imagination yet further. To the south of Salt Lake and the Mormon territory, in North America, lay a dreary series of plateaux traversed by the Colorado river and its tributaries, which bore their burthen of waters into the Gulf of California. Though that region possessed many considerable streams, it was over large areas a kind of desolate wilderness; for, instead of irrigating the ground, these streams flowed in profound gorges, in some cases more than a mile in perpendicular depth, the torrents having moulded and carved through 1,000 feet of hard granite and other substances. Of all lessons which geology, geography, and the exploration of the world taught them, that of the Cañons of the Colorado was, he thought, the greatest exhibited.

Mr. E. A. PANKHURST illustrated his remarks by diagrams hung upon the wall.

During the evening light refreshments were served in the Drawing Room by Mr. E. Booth.

MARCH 12.

FIRST MEETING AT THE FREE LIBRARY AND MUSEUM.—MR. G. SCOTT "ON THE GEOLOGY OF THE BRIGHTON MUSEUM."

In welcoming the Society in that room he expressed the feeling shared by every member of the Town Council. Many had long hoped that the time might come when there would be some centre in Brighton where science and literature could find an abiding home. He sincerely trusted that the Free Library and Museum, voluntarily supported by the public, and extending its privileges to all, might become that central home, by attracting to it similar Societies.

It was the very aim of the Free Library and Museum to assist in every way such a body as the Natural History Society, the members of which, recognising how little the wisest really knew and how much the most learned had yet to learn, were engaged in real work and earnest study. The Society could look back with satisfaction on much good work honestly done; all remembered many pleasant and instructive evenings in the old home, and he hoped and believed that under that roof, and surrounded by their growing library, many happy and useful years were before the Society in the future. He was also sure the public would duly appreciate the boon of having so large a number of valuable scientific books placed within their reach for reference and study in the Reading-rooms, and that no one in or out of the Society would have cause to regret a bargain which had so many advantages, including one dear to the legal heart—that of mutuality. They would, he knew, excuse these introductory remarks on such an occasion, and allow him to add that he felt much indebted to Mr. Gwatkin and Mr. R. Glaisyer, for the kind and cordial way in which they had handed over to his keeping the books and other property of the Society. And with a President and two Honorary Secretaries so earnestly desirous of co-operating with him and the public authorities, for the benefit of the public and of the Society, nothing but good could result from the arrangement so happily inaugurated that evening. Taking advantage of some promise more or less imaginary, their Secretaries had insisted that the first paper in that room should be read by him, and that the subject of it should be —" THE GEOLOGY OF THE BRIGHTON MUSEUM."

His aim would be simply as possible to place before them the state of an important department of the Museum, and so to treat the subject as to bring about, if possible, a rather more general discussion than they usually had on geological subjects. First of all, as an act of justice to an esteemed member of the Committee and Vice-President of this Society and to other old fellow-workers, he wished to correct a statement to which his attention had been called, namely, " That the Geological Collection at the old Museum was a complete jumble." For want of someone on the spot who knew or cared anything about the matter, dust had become a very largely developed deposit, and every specimen had to be cleaned and remounted. From the same cause, as specimens came in they were often placed anywhere, and in some of the lower cases they were simply stored.

Originally the collection was arranged stratigraphically ; with the exception of the Chalk and Cave remains, which from want of space had to be kept in another room, the various deposits were in their proper sequence, and though far from complete—as, indeed, they still were—at the worst stage, which was reached after Mr. Peto left Brighton, the collection never deserved to be called a mere "jumble." It must also be remembered that the Chalk collection was mounted and named there, at Mr. Willett's expense, just as it existed in the New Museum, although it had now been found practicable to have that noble collection placed in its proper position with reference to other formations.

For the sake of brevity, he would consider, first—What they wished popularly to teach in a Geological Museum ; and then—How they had been able to do it in the Brighton Museum. As to the first, a notion has been rather encouraged that some new light had suddenly dawned upon the Committee with reference to Geology, and to systematic arrangement. Now, with the exception of Mr. Crane and Mr. Shillingford, who had been admirable as workers, every member of the new Geological Committee had been for years a member of the old; and to show that the old Committee fully recognised the desirability of the state of things which, with more suitable rooms, they had now in some measure carried out, he might be permitted to quote the following sentence from a communication which he had made to the Brighton papers so long ago as 1867 :—" In the Geological Section, when the various sub-divisions of the different formations, with the characteristic fossils of each are exhibited and marked; especially when so arranged as to show at a glance an epitome of the entire series of fossiliferous rocks, in a descending order, from the present surface of the globe, and passing downwards through the Tertiary, Secondary, and Primary deposits to the Igneous rocks, the advantages to the student cannot be exaggerated of enabling him to pursue his studies in the Museum itself, so as to acquaint himself with the nature, order, and design of strata representing the whole range of Geological History." To say nothing of the acknowledged practical advantages of this study, it had long been unnecessary to apologise for the high place claimed for Geology among the Sciences, for as an eminent writer had said, " It is, indeed, not so much one science, as the application of all the physical sciences to the examination and description of the structure of the earth, the investigation of the agencies concerned in the production of that structure, and the history of their action."

Another Geological chieftain, Sir Charles Lyell, said, " Geology is the science which investigates the successive changes which have taken place in the organic and inorganic kingdoms of Nature. It inquires into the causes of these changes, and the influence which they have exerted in modifying the surface and external structure of our planet." That is, they had to give the means of studying not only the animal and vegetable contents of the rocks by means of Palæontology—the study of ancient life—but also the succession and causes of phenomena which, since the origin of our globe had brought about such mighty changes, and which, in greater or less degree of activity, were still in operation. They had, in short, so to open and expound the great book of the rocks, as to show the workings of the Almighty hand and the all-wise operations of the Divine will since the period, far back in the ages of the past, when, we are told, in language as exact as modern science could supply, that "God created the heaven and the earth. And the earth was without form and void."

As an example of the continuance of geological phenomena, he might mention that in studying Sir Samuel Baker's Nile Tributaries they were in the midst of the very same set of causes which brought about the Wealden formation—great rivers, the Athara, Settite, Salaam, Royan, and many others, which were mere sandy beds during the dry season, where the Arabs pitched their tents, became, when the rains began, noble rivers, 500 yards wide, carrying down to the Nile enormous quantities of mud, or rather of mould, washed into them by the torrents of rain from the rich table lands through which they flowed—and all this borne down by the Nile, not alone to fertilize Lower Egypt, but to be carried out to sea, there to form a new Delta, a new Egypt, beneath the waters of the Mediterranean. But besides these higher aims they must be prepared in such an institution to furnish instruction to many who were ignorant of the first principles of Geology, and even of what the science meant.

Had any illustration of this been needed, it would have been supplied by the popular ideas respecting the great experiment now going on in the pretty rural glen at Netherfield; for many as had been the difficulties encountered, they had been quite equalled by the number of surgical operations necessary to get into people's heads what the Sub-Wealden boring was for, and what it was not for. So that they must patiently bear with those who looked round the room and said, "Oh, stones and things," or "These are the things that they dig out of the ground"; or who, getting a step higher, say to each other, "Ah, Geology, all about strata, and so on;" or again, when we think we have been interesting some one in the wondrous story told by some fossil bone or shell, we are met with the question, "Isn't it a petrifaction?" They must be prepared to make plain many things which scarcely occurred to them as requiring explanation, such as the true meaning of such terms as rock, fossil, igneous, fossiliferous, strata, formation, and so on. There was one thing which the lecturer or teacher sometimes overlooked, but which he should strive to know, namely, what it was that the learner did not know, and therefore needed to be taught.

Coming to the second enquiry, "How had they been able to supply the popular teaching of Geology in the Brighton Museum?" it must be borne in mind, that, as in the Library, they had had to work with the materials which they found at their disposal, and with such voluntary contributions in the way of specimens as they could obtain, for they had not asked for a farthing of public money to expend upon the Geological section. They were arranged, as had been indicated, stratigraphically and zoologically, though they did not at present come up to his ideal, since it had not been found possible so to place them in one room, and partly in wall-cases, partly in table-cases, as to make them tell their own story. Still, when the general plan was understood, the order of arrangement was tolerably complete, and in carrying it out, and especially in distinguishing the upper, middle, and lower divisions of the different formations, they had the benefit of the practical skill of Mr. Etheridge, of the Geological Survey, and of Mr. Woodward, of the British Museum.

The series began with the Quarternary case on the east landing, containing remains of hyena, rhinoceros, elephant, &c., from several English and Italian caves, associated with human weapons, and also the teeth of the elephant from different parts of Sussex ; and it was resumed in the eastern room on the west side of the first table case, where, after a selection from the glacial beds of Bracklesham and the river gravel of Cambridgeshire, the Tertiary or Cainozoic rocks began, and passing round the case the Pliocene was arranged. The collection of characteristic fossils from the Norwich, Red, and Coralline Crag had been considerably enlarged by the liberality of Sir Cordy Burrows, Alderman Hallett, and Mr. Willett, who had made purchases of many fine and rare fossils, and Mr. Jesson, Mr. Shillingford, and others, had also made some important additions. The series was then resumed at the north-east corner of the wall-cases. Here the case set apart for Miocene was empty, for Miocene fossils were found in Britain only in the Isle of Mull and at Bovey Tracey, in Devonshire. At the latter place the cutting where they were found had been discontinued. But several Museums were anxious to obtain specimens, even those in the district being without them, and should a cutting for the purpose be opened, Captain Henry Hill, for the honour of his native county, would bear the expenses of their share. The Eocene was very fairly represented, and they hoped before long to have the local beds in a very complete state.

Coming to the Chalk collection, it was so widely known that it was unnecessary to say much. That it was one of the finest in existence was known to all, and Mr. Willett, in presenting it to the town, provided a monument of the scientific work of many years of an otherwise busy life. Mr. Etheridge, of the Geological Survey and Museum, assured him that there were not three such cases in Europe.

The Wealden collection, to which this Society made a handsome presentation, promised to become once more worthy of the county. Mr. Willett was constantly making additions, and Professor Rupert Jones was now making a selection of Wealden specimens, iguanodon, &c., which formerly belonged to Dr. Mantell, and he was sure they would all be glad to see them, by the Professor's kindness, restored to Brighton.

As an illustration of the advantage of having more Museums than one, he would show a little fossil plant. At the cleaning period, he found it broken in pieces. He mended and mounted it, and a fortnight ago pointed it out to Mr. Carruthers, of the Botanical Department of the British Museum. He at once pronounced it to be not only the rarest thing in the Museum, but that, as far as he knew, it was absolutely unique. A different specimen was figured by Mantell, as "a beautiful and rare plant *Cycadites Brongniariti*, in sandstone, Tilgate beds." That specimen had entirely disappeared, and he hoped to have the pleasure of lending theirs to Mr. Carruthers to be figured, as the only one known to be in existence.

The Oolitic collection was contributed almost entirely by Sir Cordy Burrows; and the Lias included fine reptilian and other remains, presented by Dr. Seymour. The cases for the Cambrian, Devonian, Permian, and Trias, were almost empty; but they hoped that by presentations and otherwise these vast formations, as well as the Gault, and others, would soon be more fully represented.

Friends of the Museum, both residents and visitors, had already done much in this way, especially in the Greensand, some of the promises made during the Brighton meeting of the British Association having but lately been carried out.

Leaving the British-room, the Northern Gallery was devoted to Mineralogy, arranged in four cases, and to the rocks and products of existing Italian volcanoes, the latter presented by Mr. T. Davidson, F.R.S. The case on the west landing was one on which, like those last-mentioned, he could not now dwell; but, as opportunity offered, he wished it to be made much more complete than it was. It was devoted to the Igneous rocks, which were arranged in the three simple groups—Volcanic, Granitic, and Trappean.

The room opposite was entitled Foreign Geology, and it contained the extensive Paris Basin collection, collected and presented by Mr. T. Davidson. This admirable collection showed by beautiful rock and fossil specimens, the various beds of this remarkable basin, from the Chalk up through the plastic clay, the marl, the gypsum, and other subdivisions, to the Post Pliocene, so that it really formed an epitome of the whole range of the Tertiaries.

In this room were also some fine Mammal bones, including a very perfect head of the Hippopotamus from the Miocene of India; but beyond a number of unarranged specimens from America, Tasmania, &c., there was little else to justify the title of Foreign Geology, and the question arose, was it desirable or otherwise in such a Museum as this to divide Geology into British and Foreign? Of course, to gentlemen engaged exclusively on the Survey and the study of the Geology of the British Isles, there was a great advantage in keeping the British collection distinct, and there was a real gain in being able to take British Geology as a part of the whole, so as to learn what formations existed or did not exist in these islands, and to ascertain the various epochs and mutations of form, and of animal and vegetable life, to which they had been subject. At the same time it was a fair subject for discussion, whether we did not not lose as much as we gained by the separation, and whether they did not thereby increase the difficulty to the unlearned, and even to the diligent learner, of grasping the meaning and scope of Geology as a whole, and of looking, not at this or that particular country, but at the globe itself, as the theatre of geological revolutions.

If they were to represent Foreign Geology, how many foreign collections must they have? Take for instance the Miocene, since at present it was unrepresented in the British-room. In the Foreign-room they had the Miocene of the Paris Basin, the Miocene of Touraine, the Miocene of Malta, the Miocene of Germany, and the Miocene of India. Were all these to be kept as distinct collections, or would it not be more instructive if they all fell into their places in one comprehensive series? Again, by simply dividing the Miocene from the

Eocene and Post Pliocene of the Paris Basin collection, and arranging each with the corresponding English beds, a really grand series would be the result; the separation would be but slight, and the Paris Basin could still be studied in its entirety, and yet fall into its more extended sequence instead of being as at present merely hung up by itself. Would it not, to take other instances, be an advantage to have the fossil fruit of the palm (*Nipadites ellipticus*) from the Brabant equivalent of the London Clay, shewn in a general Eocene series, instead of occupying a solitary corner? and the same remark applied to the crocodile bones from the French Oolite. Once more, when studying the Lias formation, would not the interest and the benefit be increased by having side by side with our English specimens the series of fossils now banished to the limbo of Foreign Geology, which were brought by Mr. Dunlop, C.B., from a bed in the Himalayas, 13,000 feet above the level of the sea? For, after all, what was English and what was Foreign? This was a wider consideration than that relating say to foreign and English entomology or botany.

The existing levels of the land, and intervention of seas, were but matters of to-day. The same Chalk formation bid defiance to the narrow strip of sea, and after forming its bed re-appeared on the Continent. The same Wealden of which they were proud in Sussex extended into France; and should the Palæozoic rocks be reached in the Sub-Wealden boring, they would be part of the same Palæozoic floor with which geologists and miners were familiar in Belgium. He would not detain them longer, and although he had thrown out his later remarks in an interrogative form, he had no desire to intimate the direction which the discussion was to take. Although, also, he had spoken of deficiencies quite as much as present possessions, the collection, even at this stage, was one of which the town had reason to be proud. That it and all the other departments of the Institution would increase and improve there would be no doubt, and he was quite convinced that the fullest discussion could only tend to promote the good of the Museum and Library, and along with it the best interests of the Brighton and Sussex Natural History Society, which this evening took up its abode beneath the same friendly roof.

The CHAIRMAN proposed a vote of thanks to Mr. Scott, for the paper he had read. He thought the members would agree with him that Mr. Wonfor had done right in putting a little pressure upon Mr. Scott to induce him to read the paper which they had just heard at this, their first meeting in the place. It was full of interest, and the subject could not have, perhaps, been so well dealt with by any one who was not situated as Mr. Scott was. He had been reminded by the Secretary that they had very nearly reached their majority—the Society had been in existence nearly 21 years—and he hoped that when they had become a man, and now they had got into new quarters, where they had the opportunity, they would do something more than they did in their childish days.

Mr. WONFOR remarked that Mr. Scott had in his paper brought before them plenty of new facts, notwithstanding that he had disclaimed doing so. In regard to the classification of the British and foreign departments of Geology in the Museum, the local and foreign collections of Zoology, &c., in the Museum were placed side by side. In the specimens representing a series or order of birds, foreign and British had no distinction whatever, there was the name only, as to whether they were British or foreign, still they were placed as they would be in a general collection. Therefore it seemed to him that this mode should be carried out in the arrangement of other departments in the Museum.

Let them do all they could to develop the local geology of the county, and he had heard that their local Geology was well developed, and that they had admirable collections from the Chalk and Wealden; still they had specially to consider the education of learners in this district, and this could not be done unless they placed before their minds the great grasp of the general subject. So far as British and foreign geology was concerned, they were mere names brought about by accidental circumstances, it was not like flora and fauna, specimens of geology could not live, they could not grow in this island, the same series existed in other places, and he thought the British and foreign specimens should be placed side by side.

The PRESIDENT, although not a geologist, supported the same view, as he thought if they had a broad science which extended over the world, they should not restrict themselves to local and insular matters.

Mr. PANKHURST remarked upon the fact that in their Society every science seemed to have more interested in it and who were able to talk about it than Geology.

MR. CAPRON, to whom Mr. Scott had alluded as having a collection of geological specimens from the Sussex Chalk equal to the one in the Brighton Museum, next spoke. He said that his collection was not equal to Mr. Willett's, although he believed it was second to it. He had been induced to give his attention to the matter solely by Mr. Willett, whose collection he had previously inspected, and Mr. Willett had handed over to him the pits he had been in the habit of exploring on the condition that he should treat the men who worked them in the same manner as he had been in the habit of doing. He had been in the habit of going round the pits once a month, the men saving the fossils for him, and whether there were any good specimens or not, he had paid them the same. If he found more specimens than one of the same kind, he left them in the pit for the good of others, as the value of a collection did not depend upon multiplying specimens of one kind. By visiting the pits once a month he had got a collection which was far superior to almost any collection but that of Dr. Mantell. Mr. Willett had, however, always behaved fairly to the labourers, and when he had obtained good and rare specimens from them he paid them well for it, and they would find it best to always behave fairly to the men, who would then treat them in the same manner (hear, hear).

MR. CAPRON then described at some length how two pieces of a very rare specimen of a reptile, *Longicolles*, had come into his possession at different times but which appeared to be different parts of the same reptile; however, he was not quite sure of it, so he had given the portion obtained last to the Brighton Museum.

Mr. DENNET remarked that he had recently, when visiting the South Wealden Boring, seen the same sort of clay brought up from a depth of 480 feet as he had seen on the beach at Boulogne. He advocated a system of exchanges between this museum and the museums of other countries.

Mr. WONFOR pointed out how much good might be done if the members would, when out for their summer holidays, bring home specimens from the places which they visited.

Mr. CAPRON said that many specimens might be found in the red chalk of Hunstanton and Yorkshire which were not found in Sussex. Yorkshire was especially rich in sponges.

Mr. SCOTT, in concluding the discussion, replied to some remarks that had been made, and said that they now had many workers in

Sussex, especially amongst the young people. A system of exchanges between this and other museums had already been adopted, and he should be glad if collectors would think of the Museum as well as of their private cabinets, as any specimens would be useful for exchange.

MARCH 26TH.

MICROSCOPICAL MEETING.—MR. T. H. HENNAH ON ILLUMINATION.

Far more depended on the proper illumination than on the objectives; inferior ones being made to show a good deal, while good ones without it failed to show anything like a proper performance. If objects were illuminated by transmitted light, parallel rays were very important, no matter what the illuminating apparatus, whether mirror, condenser, or prism. By carefully attending to this, almost any structure might be brought out by the mirror alone, without having the expensive substage appliances often recommended.

The angle of illumination should not exceed 90°, otherwise, instead of clearness, there would be indistinctness and confusion. No matter what the form of substage appliance, the light should be exactly focussed on the object, a point to which sufficient attention was not always paid. For thin and lined objects, or for diatoms, oblique rays were essential, but, for thick ones, direct rays were necessary.

There were several different methods of obtaining direct or oblique illumination by substage apparatus, such as the ordinary and flat mirror, the Nachet and Amici prism, the Reade's prisms, and the various forms of Achromatic Condenser; the action and mode of using each was described, preference being accorded, when the substage admitted of its application, to the Amici prism.

The different methods for illuminating opaque objects and for obtaining dark ground illumination, were the bull's-eye condenser, the Leiberkuhn, Parabolic illuminator, Wenham's parabaloid, &c.

After a vote of thanks to Mr. Hennah, the Meeting became a Conversazione, when interesting objects were exhibited by Messrs. Hennah, Haselwood, W. H. Smith, and Dr. Hallifax, the last-named also exhibited brass plates designed by Mr. D'Alquen, and having central black spots of different sizes, to be used with transparent objects, when it was wished to see them as opaque objects with the Leiberkuhn.

APRIL 9TH.

ORDINARY MEETING. — MR. F. E. SAWYER ON "WINDS," WITH REFERENCE TO THOSE PREVALENT IN SUSSEX.

Solar heat was the chief cause of the winds. The principal winds were formed near the equator. The air in the tropics became heated and expanded, and thus being lightened, ascended; cold air from the poles rushed in to supply its place, and so two currents of wind were formed, the upper current of warm air flowing from the equator to the poles, the lower one of cold air from the poles to the equator. The revolution of the earth caused these currents to diverge, and in the northern hemisphere turned the warm upper current into the south-west wind, and the cold lower current into the north-east wind; and in the southern hemisphere the upper current into the north-west wind and the lower into the south-east. The upper currents did not descend to the surface for some time after leaving the equator, and consequently in the northern tropical belt the north-east wind prevailed, and in the southern tropical belt the south-east wind, and these winds are known as the "Trades." At a distance of about 30 degrees from the equator the equatorial currents descended to the earth, and came into collision with the polar currents, causing violent storms in these regions.

If all parts of the earth maintained throughout the year the same relative position with regard to the sun, the four winds described would blow without intermission, but in the summer the northern hemisphere was inclined 23½ degrees towards the sun, and in the winter the same distance away from it. The earth's axis was only vertical on March 21st and September 21st in each year. This difference in position disturbed the four principal wind currents, and made them more variable, and probably was the cause of the "monsoons" which blow in the Indian Ocean. The north-east monsoon blew from November to March, and the south-west monsoon from the end of April to the middle of October. These periods coincided almost entirely with the periods during which the northern hemisphere was inclined to and from the sun, Cyclones were amongst the greatest wind storms which occur. They were mostly of a circular form, and varied in size from fifty miles in diameter to several hundred. Buijs Ballot, the Dutch meteorologist, says :—"It is a fact above all doubt, that the wind that comes is nearly at right angles to the line between the places of highest and lowest barometer readings. The wind has the place of lowest barometer at its left hand and is stronger in proportion as the difference of barometer readings is greater." This applied to the northern hemisphere, the reverse occurring in the southern. This law was important, as it enabled us clearly to understand the modern cyclonic theory. If there was a region of low atmospheric pressure in the northern hemisphere, by drawing lines from the centre of the circle, where the pressure was lowest, to the circumference, where it was higher, then we found the wind came at right angles to each of these lines, having the centre of depression on its left hand ; the winds would thus blow round the depression against the sun or in the reverse direction to that of a watch's hands. Another way in which the same law was stated was "that with your face to the wind the centre of depression is on the right hand." Of course the law was reversed in the southern hemisphere.

According to Buijs Ballot's law, if there was a region of high pressure in the northern hemisphere, and the lines were drawn as before-mentioned, from the centre of high pressure to the places of lower pressure around, the winds would then come at right angles to these lines, with the low pressure outside and on the left hand : the winds would thus blow round with the sun or with the hands of a watch. To this phenomenon Mr. Galton gave the name of "Anti-cyclone," on account of its being the exact reverse of a cyclone. In the centre of a large cyclone there was generally a calm. It was considered by many, and probably very correctly, that all the winds which prevailed in Europe were cyclonic in character ; a careful investigation of the daily weather maps for two or three weeks would show that several cyclones and anti-cyclones had passed over this country. Recently, however, a serious question had been raised as to the form of cyclones. Mr. Meldrum, Director of the Government Observatory, Mauritius, stated that, as the result of several years' observation, the cyclones in the Indian Ocean were not circular, but elliptical, and that the wind blowing from points from N.E. to S.E., blew almost directly towards the centre. Now, according to the previous rule, with the wind blowing from S.E., in the southern hemisphere, a sailor would assume that the centre of the cyclone was in the N.E., and accordingly steer for N.W., so as to pass the centre; but by the new rule he would sail straight to the centre.

The necessity of a correct knowledge of the laws was shown by the fact that in one on February 25th, 1860, this mistake was made, and thirty-one vessels were lost near Mauritius, amounting in value to £134,000. In cyclones of the elliptical form the wind curved in towards the centre, and they were therefore called "incurving cyclones." It was not yet known whether any incurving cyclones were ever felt in the northern hemisphere, or, indeed, outside the Indian Ocean; but it was thought that the Atlantic hurricane of August 20 to 24, 1873, was of that character.

The velocity and force of the wind were recorded by instruments called anemometers. Those for the velocity had been invented by Robinson and Whewell, but Robinson's was most commonly in use. The chief pressure anemometer was invented by Osler.

The relative prevalence of the wind was shown in the following table, which gave the average number of days the wind blew from each point of the compass in each month, the average being for six years, 1868 to 1873 inclusive. The observations were made from the vane of St. Nicholas Church, Brighton.

The Uckfield annual totals were given for comparison.

Number of days wind blew from

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm.
January	3	5	3	2	4	6	7	..	1
February	3	4	2	1	3	6	6	2	1
March	5	6	2	2	3	5	5	2	1
April	4	6	2	3	2	5	6	2	..
May	2	6	2	3	3	6	6	2	1
June	3	3	1	2	2	8	7	1	3
July	2	4	1	2	3	10	6	1	2
August	3	3	2	3	2	7	6	2	3
September	2	4	3	3	2	6	7	2	1
October	3	2	2	2	4	5	8	4	1
November	6	6	2	1	3	5	4	3	..
December	6	5	1	1	5	5	6	2	..
Total	42	54	23	25	36	74	74	23	14
Uckfield average, 27 years.	25	60	35	24	19	96	68	37	...

From this it would be seen that both at Brighton and Uckfield the

S.W. and W. had the greatest prevalence, while at Brighton the E. and N.W. were least prevalent. During the last few years the study of meteorology had made great progress in the county of Sussex, and there are now four anemometers at work, all of Robinson's pattern. The observers were C. L. Prince, Esq., F.R.A.S., Crowborough Beacon Observatory; Rev. T. E. Crallan, M.A., County Asylum, Hayward's Heath; W. J. Harris, Esq., F.M.S., Worthing; and F. E. Sawyer, Chain Pier Head, Brighton.

The average distance travelled by the wind at Hayward's Heath daily in 1872 was 170 miles. The greatest distance travelled in 24 hours yet recorded was 990 miles on December 8th, 1872, at Crowborough, the amount at Brighton that day being 904. In the gale of September 28th, 1872, the wind travelled 916 miles on 28th at Crowborough, and 901 miles at Brighton.

The year 1873 was very free from heavy gales, and the greatest daily amount recorded was 823 miles at Worthing, on August 28th.

In the following table the result of the observations for each month in 1873 are given: -

TOTAL HORIZONTAL DISTANCE TRAVELLED BY THE WIND.

	Brighton	Worthing	Crowborough
	Miles.	*Miles.*	*Miles.*
January	13,488	...	11,979
February	7,667	...	6,488
March	7,871	...	8,694
April	8,760	...	7,587
May	9,043	9,764	6,284
June	7,962	9,009	5,819
July	10,308	11,522	6,270
August	12,846	12,638	...
September	10,010	9,759	8,810
October	9,566	...	8,040
November	10,767	10,716	...
December	8,119	8,005	...
Total	116,407		

It was probable that the great difference between Brighton and Crowborough was caused by the difference in level, the anemometer at the latter place being about 830 feet above the sea, and at the former about 35 feet.

The President, Mr. HASELWOOD, remarked upon the unsatisfactory state in which Meteorology stood, and upon the general ignorance respecting it; at the same time pointing out the great advantages which must accrue from its patient, careful, and intelligent study He was inclined to think that the humidity of the atmosphere had a great deal to do with winds as well as heat.

Mr. G. SCOTT considered it unfair to make comparisons when the results were tabulated at different elevations: for the purposes of comparison the return should be from places of the same elevation.

Mr. SAWYER remarked that returns which had been forwarded to him from Rotherham, in the North of England, showed that Brighton experienced nearly double the amount of wind which that place did.

Mr. E. HAMBLIN questioned whether elevations made such a great difference in the wind as was supposed.

The PRESIDENT: You have only to take a walk up to the Downs to find the difference.

Mr. H. SAUNDERS thought the upper part of a cyclone was sure to travel swifter than the lower, as was the case with a stream of water.

Mr. SEWELL controverted the supposition that Brighton should be avoided in March in consequence of the prevalence of winds. There was far more wind in the Eastern Counties than in Brighton during this month. It was most desirable that this should be known, in order that the prejudice against Brighton which obtained in some quarters might be removed.

The PRESIDENT and Mr. A. DOWSETT both corroborated Mr. Sewell's statement with respect to there being much more wind in the Eastern Counties than in this part of the country.

Mr. SAWYER promised to obtain what returns were procurable as to the character and quantity of the winds in March. He also took this opportunity of mentioning two facts which he had not referred to in his paper. First, cyclones had a two-fold movement; they moved onwards as well as round, though but comparatively slowly. Second, anti-cyclones sometimes appear in a place, develop, and then disappear.

Mr. G. SCOTT adverted to the comparative untrustworthiness of anemometers, and suggested the possibility of the indicators going further than they should. Should not the instrument be stopped at given intervals—say every half-an-hour? The returns, he thought, were much more likely to be accurate if this were done.

Mr. SAWYER admitted that different sized instruments gave different returns.

Mr. W. H. NASH was of opinion that Osler's was a much more accurate instrument than Robinson's.

APRIL 23RD.

MICROSCOPICAL MEETING.—MR. WONFOR ON "PLANT CRYSTALS."

In most of the manuals on Botany or the Microscope, certain crystalline bodies found within the cells of plants were designated by the name *Raphides*, or needle-shaped bodies, a term inapplicable to some, because they were not needle-shaped, and on the whole misleading, because in the lists of plants generally given as containing them, it would seem as though their appearance was an accidental circumstance in the economy of the plant, instead of a constant quantity, not confined to one period of the plant's growth, but found in all stages of its existence.

The first to reduce to something like order and to indicate the value of Plant Crystals, in determining the differences between plants of otherwise closely allied families, was Professor G. Gulliver, by whom they had been arranged into the three groups—*Raphides*, *Sphaeraphides*, and *Crystal Prisms.*

Raphides were transparent colourless crystals, needle-shaped, and tapering to a fine point at each end, loosely connected in bundles of twenty or more in oval or oblong cells of slightly larger dimensions than themselves. The slightest pressure on the tissues of a portion of a plant, when under examination, causes them to escape from their cells. Examples could easily be obtained either by making thin sections or simply tearing with needles a portion of the tissues of any member of the balsams, woodruffs, evening primrose, arum, orchis, and some of the iris family

Sphaeraphides were more or less rounded, often spherical bodies, made up of white or opaque crystals or crystalline matter. In some the ends of the component crystals projected, and gave them a star-shaped appearance. They were much smaller than their cells, and, in some cases, were thickly studded throughout the cellular tissue. This was the case with many of the cactus family, some of which, when aged, had their tissues so filled with them as to render the plants very brittle. It was mentioned that plants of *C. Senilis*, reported over a thousand years old, when sent to Kew Gardens, had to be packed in cotton as carefully as if they were delicate glass or jewellery. The fruit of the prickly pear was full of *Sphaeraphides*, examples of which were easily seen in the crane's-bills, elm, beet, spinach, or violets.

Crystal prisms were found either singly or two, three, or at most four, together in combination within the same cell. While under a low power *raphides* did not present angles or faces, crystal prisms presented both; instead, too, of tapering to a point at both ends, they were wedge-shaped or angular. Some were three or four-sided, while others were octohedrons. They were larger than *raphides*, and were not, as a rule, easily separated from the tissues in which they were seated. Examples might be found in the green-pea shell, the garlic, green fig stem, gladiolus, &c., and very abundantly in the soap tree of South America, used in Peru as a substitute for soap in the cleansing wool or hair, or in washing.

Chemically, plant crystals were chiefly composed of oxalates of lime and magnesia, or phosphate of lime.

Professor Gulliver's researches showed that so persistent were *raphides* in certain families of plants and so absent in others, that it was possible to differentiate, at all stages of their growth, between plants otherwise apparently allied. Thus *Onagraceae* and *Galliaceae* abounded in *raphides*, while none of their near neighbours contained them. So likewise the red berries of black-bryony and cuckoo-pint could be distinguished from those of red-bryony and guelder-rose, by the presence in the first two and the absence in the last two of *raphides*.

To the botanical student, characters such as those indicated were of very great value, and to the microscopist a wide field of research was opened, for not only would he find plants containing one or other of the plant crystals described, but great differences in their shape and size, many of them too, under polarized light, being very beautiful; while a lesson was to be learnt by all—that they were not accidents of decay or disease, but part of the economy of life in the plants in which they were found.

A conversation ensued, in which Drs. HALLIFAX and CORFE, and Messrs. GLAISYER, the PRESIDENT (Mr. Haselwood) and Mr. WONFOR took part.

Mr. HENRY LEE, having been called upon to address the meeting, said that the few remarks he had to make belonged more properly to the conversazione part of the proceedings; but they would perhaps not consider him out of order, as this was the first time he had appeared before them, if he expressed his gratitude to them for the kindness shown him in electing him an honorary member of their Society. It struck him that he might be useful occasionally, as he was to the Society at Croydon, over which he was President, in bringing down microscopical objects for mounting and distribution, such as the skins of dog-fish, eels, &c. It might be useful, while he set some of them aside for this purpose, and which he should be glad to present to any of the members of the Society, if he mentioned, as hints to the younger members, for he did not profess to teach the older and experienced microscopists before him, how he found it best to mount the skins. The usual mode was to mount them as opaque objects, and, as the tops of the spine were brittle, to do so either in a dry cell or in balsam, which gave them a good opportunity of examining them by polarized light. This conveyed to them a splendid colour, and showed that vessels seemed to extend down the spine, the same as down the teeth of the rays and sharks. There was another method, namely, dissolving out the animal matter by means of liquor potassæ, and well-washing in distilled water. By doing this the spines with their socket attachments were well shown; but it should be remembered that they should be soaked in turpentine for some time before mounting in balsam, or the venation would be filled with air. He did not think that there was anything else he needed to state, except in reply to questions which, if put, he should gladly answer. The specimens which he had brought with him for exhibition and distribution that night were from the skin of the rough hound; and from time to time he would bring down portions of skins of all the dog-fishes, so that the members of their Society might each have a perfect series in their cabinets.

The PRESIDENT (Mr. Haselwood) was sure that he would only be expressing the feelings of the Society when he said that they should be delighted to have Mr. Lee's presence from time to time, and receive valuable suggestions from his practical knowledge; that they hoped he would often find time to pay them a visit; and that they heartily thanked him for the specimens he offered them.

Mr. HENRY LEE remarked that there was one thing which he had forgotten to mention, namely, that in showing the objects he submitted, much depended on illumination—the manner in which the light fell upon them—and he would suggest, to younger members especially, that if they were in the habit of working with their lamp on any particular side, they should always put the label on that side where there was the best illumination, and towards the lamp. They would then always be able to place the object in the best position.

Mr. T. W. WONFOR observed that Mr. Lee had come to exactly the same conclusion in mounting the skins of dog-fish as that at which he had arrived in mounting the wings of butterflies and moths.

Mr. G. D. SAWYER was glad that Mr. Lee had thought fit to speak of several elementary facts, for they were of great service to those who were working up from the bottom of the ladder; and he hoped the more experienced microscopists would always, when they were lecturing, assume the presence of those who had to learn the first practical truths.

After votes of thanks to Messrs. Wonfor and Lee, the meeting became a conversazione, when both gentlemen exhibited very interesting objects, illustrative of their respective remarks.

It having been intimated that Dr. Hallifax had presented eleven micro-photographs to the Society, a vote of thanks was awarded to him for his gift.

MAY 14TH.

ORDINARY MEETING—SPECIMEN EVENING.

SAWDUST ORNAMENTS.

Mr. T. W. WONFOR opened the exhibition of specimens by showing a medallion of Ceres made from sawdust, and very much resembling *papier maché.* This was brought from Philadelphia ; it was given to him by Mr. G. H. Tatham to present to the Museum.

Mr. C. F. **DENNET** said that the manufacture of articles from this substance had been carried on in the States since 1860, and he should be happy to present a specimen of the manufacture to the Museum.

A PECULIAR FISH.

Mr. C. F. **DENNET** remarked that during the meeting of the British Association in Brighton there was much curiosity and speculation as to what a peculiar vertebrate-like object then exhibited belonged. He had since come across a paper in which the subject was dealt with, and an illustration of the animal given ; it proved to be what in the United States was called a stick-fish.

Mr. T. W. **WONFOR** said that the Alcyonium, or, as it was more commonly called, Dead-men's Fingers and Sea Paps, very much resembled the stick-fish, and was to be seen alive in the Brighton Aquarium.

Mr. **DENNET** promised to do his best to get one over alive from the States ; in any event, he would be able to present the Society with a dead one.

CREMATION.

The subject of Cremation was next discussed. It was opened by Mr. **WONFOR**, who exhibited a part of a small clay vessel, which was dug up within about 200 yards of the Lewes Road Cemetery, and which he thought, from the fact of coins and pieces of pottery being found with it, might possibly be part of a small cinerary urn. Whether this was so or not, however, there was abundant evidence to show that the early inhabitants of this country, and also the Romans and Anglo-Saxons, burnt the bodies of their dead ; and in this way rendered it impossible for the survivors to suffer in any way from the noxious gases which arose from churchyards and cemeteries.

Mr. **DENNET** pointed out that there was one advantage in being burnt. It would also prevent the decaying matter of bodies percolating springs and wells. But how about cases of poisoning and other forms of murder being found out ?

The **President** (Mr. Haselwood) said that cases of this kind very seldom occurred. Besides, there was something to be urged against every suggestion. He was glad to see that the public mind was so fully alive to the subject.

Mr. G. **Scott** was pleased that this subject had been brought forward. He had always held that the neighbourhood of the Round Hill Crescent, the Ditchling Road, and Hollingbury Castle would well repay being carefully investigated. In his opinion, however, the vessel in question was not a cinerary urn; they were generally very much larger—about half the size of one's body (and he subsequently brought in an urn from the Museum, which bore out this opinion). He was rather disposed to think that it was one of the vessels which were usually deposited with the dead, and which contained food or drink for the spirits of the departed. Mr. Scott then explained the various forms of ancient burial, and described the positions in which bodies were mostly buried when not burned.

Mr. **Haselwood**: The burning of bodies ceased about the time of the introduction of Christianity.

Mr. E. H. Moore showed that the ancients could not have had the means of reducing bodies so thoroughly as we had now; they would not be able to get so great a heat; consequently, there was a larger quantity of ashes left than there would by the process proposed by Sir Henry Thompson.

Mr. Benjamin Lomax adverted to the custom followed by the natives of Australia, in drying the bodies of their dead and carrying them about. After some further discussion the subject dropped, Mr. Wonfor half promising that the matter should be dealt with in a paper on some future occasion.

THE HABITS OF ROOKS.

The habits of rooks were next touched upon. **Dr. Corfe** enquired the reason of odd birds always being set upon by their fellows. In many cases rooks had been known to set upon single birds and kill them, and it had been suggested that it was for some social sin. Was this so; were bigamy and polygamy punishable among rooks?

Mr. Wonfor did not think the question could be satisfactorily answered. He knew an instance in which a female rook was killed by the other birds because a hen's egg (which had been purposely put there) was found in her nest; but then it was a fact that birdcatchers made a practice of laying up for males in the same spots; for as soon as one male was taken another one was soon found to mate with the female.

Mr. Moore believed the weak and sickly birds were always killed, in all probability that they might be eaten by the others.

Mr. Dennet considered this was so in many cases.

The **President** pointed out that this was one of Nature's laws in respect to birds and animals, that the old and sickly should be killed off.

ELEPHANT OR WHALE BONE.

Mr. R. Glaisyer exhibited what some believed to be a unique specimen of part of the thigh bone of a fossil elephant *(Elephas primigenius)* which was dug up at Rottingdean, and which, by the kindness of the gentleman on whose estate it was found, had been forwarded to him for exhibition.

Mr. Scott questioned whether it was an elephant bone. Professor Andrew Ramsay had seen it and had expressed his opinion that it was a whale bone, in which opinion he concurred.

Mr. **Wonfor** hoped geologists would endeavour to settle this question; it would be most interesting and important to know if it was the bone of a whale which was found in the Elephant bed. If it was the bone of an elephant it must have been a most gigantic one; but he thought it was most likely to be a whale bone.

Mr. **Benjamin Lomax** thought it might possibly be determined by a careful microscopical inspection.

LOCAL GEOLOGICAL STRATA.

Mr. F. E. **Sawyer** drew attention to the excavations being made in Russell-street, Brighton, and recommended the members to make a point of seeing the strata there laid bare before the place was walled in. The natural soil extended about four or five feet; then came about nine feet of very sandy clay; and at the bottom a great quantity of flints lying on the Elephant bed. The excavations at Portslade for Coombe Rock (Mr. Hudson's) were also worth inspecting, some interesting points being opened up there.

Mr. **Scott** said he had examined the Russell-street excavations, and they were certainly singular; and it was his intention to take a run over to Portslade at a convenient opportunity.

OTHER SPECIMENS.

Mr. E. C. **Pankhurst** also exhibited several specimens of elatenite, a singularly bituminous mineral, fossil fern, calamite, &c.

The Rev. J. H. **Cross**, a piece of the lace bark tree and other objects from Jamaica.

Mr. W. **Clarkson Wallis** and Mr. F. E. **Sawyer**, various small bones which had been found in the neighbourhood.

Mr. G. **Scott** submitted a piece of decayed wood, similar to that used in making Tunbridge ware, and which was found in the neighbourhood of Petersfield, and enquired what was the nature of the colouring substance, and if the wood was durable?

Mr. T. W. **Wonfor** remarked that it was not unless impregnated by something to make it so, and that the colouring was produced by fungus growth, and that it was the mycelium of the fungus, termed *Helotium æruginosum.*

May 28th.

MICROSCOPICAL MEETING—DR. HALLIFAX ON "THE VEGETABLE CELL."

By the term "Cell" was denoted the primary and elementary component of vegetable, and, almost, if not all, animal tissues and organs. The entire vegetable kingdom was made up of cells, in which every vital action was performed, and while some were of extreme minuteness, others were of considerable size.

The Vegetable Cell had been defined as a sac or envelope, the wall of which was composed of a peculiar chemical substance named cellulose, and in its vital condition contained fluid. There had been some dispute with regard to this definition, because in certain lower forms of vegetable life provided with ciliæ, and floating freely in water, no trace of walls could be detected ; these, he considered, were erroneously, and, by a confusion of language, called cells.

The physiological aspect of the cell was far more important and interesting than the structural, as each cell lived and performed its offices as an independent organ. If the petal of a flower, such as the pansy, were examined, it would be seen that each cell secreted its own colour, the same cell never secreting two different colours ; the purple and yellow, though appearing to blend, always being found in separate cells.

Under the microscope it was not possible to show the physiological action, but the size, form, and relation of one cell to another could be exhibited. As regarded the form an infinite variety was found, caused by the laws of growth and external circumstances, such as pressure and from contiguity with other cells.

The primary form was spherical, but the greater number were polygonal, and some stellate. Besides forming beautiful objects for the microscope, there was an interesting study in endeavouring to solve the question, whether the cell in its juvenile state was spherical, and if so, how the diverse and wondrous shapes were brought about.

It was certain that some plants, consisting of a single cell, in obedience to the law of growth, took on an invariable form, which certainly was not spherical, though there might be exceptions. Many cells too, in their immature state, were devoid of those features which marked them in a state of maturity, when they had taken on what was called secondary deposits, obtained from the primordial uticle, or protoplasmic substance, spread over the interior of the cell.

In some plants, notably the *Nitella*, examples of which he would exhibit, the cells were not only of very great length, but so transparent that the physiological action of *cyclosis*, or rotation of cell contents, was easily seen. The hairs of many plants (modified cells) also showed a similar state of things ; and it had been conjectured that a similar circulation went on in all plants, so constituting the nutritive process.

Mr. C. SMITH inquired what the value of the cell, as an anatomical unity, was in building up structures? He imagined that it was a sort of protoplasm, for if not, they had one cell developing from another, and so on *ad infinitum*. There was one plant which had not a cell in its whole organism.

Mr. T. W. WONFOR presumed that there was a membrane, and contents of that membrane.

Mr. C. P. SMITH admitted that there would be a cell if the plant itself was designated one.

Dr. HALLIFAX indicated that had there been time, he would have gone into the origin of cells; but it was an intricate subject. Of course there must be a primary stage before the cell and cell wall were formed, but to ascertain what it was, was the great problem of the day. It was called a protoplasm, and was a gelatinous or semi-fluid substance, having in itself a central germinating element called nucleus. As to the plant to which Mr. Smith referred, if he understood that gentleman rightly, it was uni-cellular.

Mr. T. W. WONFOR raised the question, how did the cell contents pass from one cell to another? They evidently did so, for the nuclei went on rotating and increasing in number and size. It was supposed by some that the fluids passed from one cell to another by endosmose and exosmose.

Dr. HALLIFAX inferred that absorption took place.

The meeting then became a conversazione, when vegetable cells, illustrative of the paper, including *Nitella*, were exhibited by Messrs. Haselwood, Glaisyer, Wonfor, C. P. Smith, and Dr. Hallifax.

JUNE 11TH.

ORDINARY MEETING.—MR. G. SCOTT ON "THE WILD CAT AND OTHER MAMMALS, RECENTLY ADDED TO THE MUSEUM COLLECTION."

The Museum collection had hitherto been very deficient in Mammals, for they started in September last with very few; but during the last few months considerable additions had been made, including several species of monkeys, the badger, fox, ferret, weasel, stoat, hedgehog, wild cat, Australian native cat, squirrel, pied hare, pied rat, water rat, seal, and porpoise, also skeletons of porpoise, mole, and guinea pig. Of these, several had been presented by the Earl of Chichester, Mr. Brazenor, and other gentlemen ; but for the greater number they were indebted to their Vice-President, Sir Cordy Burrows, either personally, or through his exertions among his friends, and his influence with the Directors of the Aquarium, who had ever been anxious to help the Museum in every possible way. Fine specimens of the great ant-eater, antelope, and lynx, and the skeleton of a monkey were nearly ready for the cases, and he had the promise of a fallow deer from West Sussex, and of the first otter which could be speared by the Master of the Otter Hounds of one of the northern counties. By going on in this way, they not only secured the typical specimens which they required, but what the public wanted still more, namely, a tolerably extended collection. He should confine himself to a few words respecting the wild cat, the Australian native cat, and the monkeys last added.

When he promised Mr. Wonfor to say something about the Wild Cat he thought nothing would be easier, but on looking into Zoological works, he found that either very little was said or that the authors were very far from agreeing. Thus, Baron Cuvier, whilst he devoted five volumes to the class Mammalia, dismissed the wild cat in seven lines ; and Professor Nicholson was still more curt, and, as far as our island was concerned, his only remark reminded one of the celebrated chapter on snakes in Iceland—all that he told us was, "The wild cat formerly existed in Britain, but was now extinct." Of course, if this were so, there would be an end of the matter, and of our Sussex specimen along with it. But this, he thought, was a fair subject for discussion, for, whilst it was admitted to be rare, especially in the south of England, and that there were many cats which had escaped from a domestic life and run wild in the woods, there were differences which could be relied upon, and he should not very readily abandon the claim of their specimen to be a genuine Sussex wild cat.

First, as to the tail. It was admitted that the tail of the domestic or escaped cat could easily be distinguished from that of the wild cat. The former was long, slender, and tapering, whilst the latter was much shorter and more bushy, and it was proved that escaped cats leading a life in the woods transmitted their long tapering tails through many successive generations. Now, the tail of their specimen was exactly that of the true wild cat, whilst the head and body were of the exact average length, 1 foot 10 inches. Other distinctive features he had not had the opportunity of observing, but the general description of the wild cat applied with perfect exactness. "The ground tint of the fur is yellowish, or sandy grey, diversified with dark streaks drawn over the body and limbs in a very tigrine manner. These stripes run nearly at right angles with the line of the body and limbs, so that the creature has been termed, with some justice, the British Tiger. A very dark chain of streaks and spots runs along the spine, and the tail is thick, short, and bushy, with a black tip and rings of a very dark hue. The stripes along the ribs and on the legs are not so dark nor so clearly defined as those of the spine. The tail is barely half the length of the head and body."

Mr. St. John pointed out that the wild cat stood higher on its legs in proportion to its size than the domestic cat; and that its strength and ferocity when hemmed in or closely pressed were perfectly astonishing. That this animal, shot in Sussex, and presented as a true wild cat, was fierce and active enough for one, might be gathered from the fact, that as it lay wounded to death it seized the retriever by the throat, and so lacerated the windpipe that the dog died the next day. It was a desperate enemy to poultry and game, especially in the north of Scotland, where it still escaped the gamekeeper's gun. The *Zoologist* for April, 1873, spoke of "that reputed Scottish mammal, the wild cat," and, "of this mythical creature," and added "there is no British mammal, or reputed British mammal, of whose character, locality, and even existence, we are so totally ignorant as the wild cat." On the 29th of the same month Mr. A. H. Cocks replied in a short notice headed "The Wild Cat not a Myth," and gave an account of one which he had kept alive for the previous thirteen months. She was one of five he had seen alive, and was trapped in Inverness-shire. He tells us "she became to a certain extent tame; that is, although she never left off her habit of perpetually swearing when receiving a visit, she will come, when tolerably happy, from her 'bedroom' to the other half of the hutch cage she inhabits to receive food." He mentioned several others which had been kept in captivity, including six within two years at the Zoological Gardens, where Mr. Bartlett has now either one or two hybrids. He had a letter recently from Mr. Bartlett respecting theirs, but he did not like to give an opinion without seeing it.

The question would be asked, had not our household cat been domesticated from the wild cat? He would not detain them by going into particulars, but it was pretty well established that the domestic cat was a descendant of the tame cat of the Egyptians, introduced into the western provinces by the Romans. In support of this view he would only mention that, whereas the wild cat was so abundant in the time of Richard II., as to be one of the beasts of the chase—that King having granted a charter to the Abbot of Peterborough, giving him permission to hunt the hare, fox, and wild cat—the domestic cat was only heard of in Britain about the 10th century, when it was highly valued, and laws were passed to regulate its preservation. Thus Howel Dha, of Wales, who died A.D. 948, fixed the price of a Kitling (which is still the north country phrase) before it could see at a penny, and till it caught a mouse at twopence. At the value of money in those days this was a large price. But, besides this, it was enacted that if anyone stole or killed the cat that guarded the prince's granary, he was to forfeit a milch ewe, its fleece and lamb; or as much wheat as when poured on the cat suspended by its tail (its head touching the floor) would form a heap high enough to cover the tip of the tail. This legal process must have been more flattering to pussy's sense of dignity than altogether comfortable to her feelings.

The little animal which had been presented as the Australian native cat, although it was not a cat at all, he introduced for the purposes of getting their friends Mr. B. Lomax and Mr. E. Moore to tell them something about it; for like many Australian animals the accounts of it in works on Zoology were very limited. Indeed, as has been remarked, "There is hardly any practical writer on Zoology who does not lament the very incomplete state of our knowledge on the subject of Australian Zoology, and those who have thrown themselves most zealously into the work, and have achieved the greatest success, have been the most ready to acknowledge the enormous gap that has yet to be filled up, and to urge others to prosecute their researches in regions which have as yet been untraversed by the foot of civilized man, and which are the most likely to be the dwelling places of creatures on which, as yet, an educated white man has never set his eye."

He would endeavour to say a few words respecting their humble cousins, the monkeys, of which they had five unusually fine specimens on the table. Mr. Wonfor was very anxious that the paper should be a Sussex one if possible, and he was glad to be able to gratify him even in the case of the Quadrumana. That little creature, the pig-tailed Macaque or Bruh, one of the cleverest, most humorous, and most thievish of all the monkeys, was brought from Singapore by one of the sailor sons of Mr. Peters, at the Dome. Mr. Peters divining that he liked dead animals better than living ones, promised that he should have it if anything happened to it. It was sent a little way into the country, got playing as little boys would, entangled its chain in a gooseberry bush, and was hanged, so that to this extent it was a Sussex monkey. As they were preparing its skeleton the nails were wanting.

It was a native chiefly of Sumatra, and when young was trained to climb the cocoa nut palms and gather the fruit, and it was said that it selected the ripe nuts only. There were several other species of macaques, as the bonnet macaque, the black macaque, and the Barbary ape, and this seemed to be the general position of all of them in walking. He might mention that should any gentleman wish to lay out a few pounds on a Barbary ape for the Museum, there was a fine one in the town, and also a large orang-outan and several other monkeys,.to be had. They had the head and skull of the diadem lemur of Madagascar, but there was not time to discuss that curious family, the members of which approached, in some respects, the quadrupeds. There were six molars at each side in both jaws, instead of five, as in ourselves, and in most of the old world Quadrumana. He was sorry they had only the head, but the commercial element was too strong for them, and the skin was made into a lady's muff. They had three examples of the Gibbon. They were all natives of Asia. They were told that the cry of the female was quite a musical performance, capable of being set to musical notes. The animal was said to achieve the chromatic scale admirably, with precision and rapidity. Beginning with E, she first ascended to the upper octave and then descended in the same way, but always sounding the lower E almost instantaneously with the upper note, whatever that note might be. In general they were all affectionate and engaging creatures, and it had been said, "If the gigantic and powerful gorilla be compared to Hercules, the light and active gibbons may find their type in Mercury, the swift aerial messenger of the Olympian deities."

There was only one other specimen with which he need detain them, the specimen of the Entellus monkey or sacred Hoonuman of India. They had all read of the crowds of monkeys to be seen in and around Indian villages, and swarming on the banyan trees, where they did just as they pleased, and took what they pleased at their own sweet will from every garden and sugar-cane field in the country. One writer told them, " They parade the streets, they mix on equal terms with the inhabitants, they clamber over the houses, they frequent the shops, especially those of the pastrycooks and fruit sellers, keeping their proprietors constantly on the watch, but no one punishing them for any delinquency." Another said, " Bangalore, a city of Mysore, is completely hidden by a dense grove which is a perfect metropolis of monkeys. Swarming in thousands, they chase each other on the roads, caper on the hedges, chatter on the boughs, and grin hungrily at everyone who passes with any eatable." Before concluding a paper which had, as usual, become too long, he might add they had occasionally heard of their distant relationship to the monkey. It was rather refreshing to have an opinion from the other side, and to learn that the monkey did not see it. Sir Samuel Baker tells us that Lady Baker's pet monkey, " being a far more civilized being than the African savages, did not at all enjoy their society, but was in the habit of attacking the unprotected calves of their legs, and amusing himself by making insulting grimaces, which kept the crowd in a roar of laughter. He was quite unhappy if out of the sight of his mistress, but he frequently took rough liberties with the blacks, for whom he had a great aversion and contempt. Wallady had no idea of a naked savage being " a man and a brother."

Mr. WONFOR thought Mr. Scott had proved, beyond a doubt, that the wild cat existed as distinct from the domestic cat ; they heard of domestic cats becoming wild, and breeding with wild cats, but he thought that this statement had not been sufficiently confirmed. As to where their domestic cat came from, they were unable to trace its originality, though Dr. Schweinfurth and others placed it in the centre of Africa. As to cats transmitting certain peculiarities to their offspring, as the absence of the tail in the Manx species, it was said they lost them after the lapse of a few centuries.

Mr. DENNET pointed out that, according to his experience, acquired chiefly in America, a veritable wild cat should possess five toes on each of the anterior, and four on each of the posterior, feet, a rounded head, elastic muscular body, strong limbs, sharp claws, and several other external characteristics. They were also gifted with acute sight and hearing.

Mr. A. **HILTON** thought that he had discovered what was not a peculiarity,—the large bushy tail,—stating that some domestic, and, on the continent, many hybrid cats, with bushy tails, twice the size of the one alluded to by Mr. Scott, were to be found.

Mr. G. **SCOTT** explained, however, that it was not in the length of the tail that the peculiarity lay, but in the short, combined with the bushy state.

Dr. **HALLIFAX** said that one of the most distinctive features of the wild, as compared with the domestic cat, was the great length of the intestinal canal. He also observed that, according to high authorities, the domestic might breed with the wild cat ; and, if so, that would rationally explain the large variety of cats.

Mr. T. W. **WONFOR** admitted that there might be cross-breeds, and that domestic cats had been known to disappear and return with progeny unlike themselves, and more or less wild ; but the question then arose—did that cat breed with a male cat, which had become wild, or with a truly wild cat ?

Mr. G. **SCOTT** maintained that the varieties of the domestic cat were produced by cross-breeding, the same as with domestic cattle, pigeons, &c. ; for the wild cat never did vary, a fact which was confirmatory of his assertion that it was a distinct species.

A discussion on the monkey followed, in which Messrs. Hilton, Shellingford, Wonfor, Wallis, G. D. Sawyer, and Mr. Scott took part.

Mr. F. E. **SAYWER**, F.M.S., reminded the members that, with reference to a paper which he read in 1872 upon Earthquake Shocks in Sussex, Mr. Wonfor mentioned that in the autobiography of Sir John Bramston, published by the Camden Society, there was a shock mentioned as having occurred in 1692, but it gave no particulars. He found a description of this earthquake in Holloway's History of Rye, which stated that the trembling of the earth under the town did not last a minute, and was felt throughout England, France, Belgium, and part of Germany, as far as Frankfort. He also corrected a statement made in his paper upon the earthquake at Brighton in April, 1873, that it was felt by a gentleman walking along the King's-road. This was not quite correct. According to a letter signed "M. F.," and dated 6th April, 1873, which appeared in the *Times*, repeated trembles were felt in a house in King's-road about ten minutes to eleven o'clock at night by persons capable of distinguishing the vibrations from those of a passing vehicle. The earthquake of 1734 he had represented as being felt only as far east as Shoreham, but he ascertained that it was felt at Lewes, and within twenty miles of the sea coast, thus giving it a much wider range than he had imagined it assumed.

JUNE 25TH.

MICROSCOPICAL MEETING.—A MARINE EVENING. —MR. H. LEE ON "YOUNG LOBSTERS."

Mr. **LEE** having brought over from the Aquarium living specimens of young Lobsters, coronacti and madrepore, Mr. **WONFOR** placed one of them under the microscope, and informed the member's present of Mr. Lee's kindness, reminding them how willing that gentleman was to communicate information to them, and expressed their gratitude to Mr. Lee for his attention. He then observed, with reference to the young Lobster, that naturalists believed at first that it was a distinct species of crustacea, but that they had now ascertained what it really was.

Mr. **LEE** drew attention to the abnormal size of the eye of the young Lobster, the peculiar feet which existed in all larvæ of crustacea, and the spatulate instead of the five-lobed or divided tail, as possessed by the adult. In order to show that the animal really constituted a subject of modern investigation, he remarked that he once entered into argument respecting young Lobsters with Mr. Lord, the late Curator of the Aquarium, and now deceased, and he denied that Mr. Bell, in one of his works, was right in attributing spatulate tails to them ; but afterwards, having been shown a specimen through the microscope, he acknowledged that Mr. Bell's opinion was quite correct.

In reply to Mr. Wonfor, Mr. **LEE** said that the Lobster had been traced from the ovum to maturity. In no Aquarium, however, had any of the young of that shell-fish been reared. In the Brighton Aquarium an endeavour had been made to do so; but he considered that the investigations were still just commencing.

In answer to Mr. Dennet, Mr. **LEE** said that it was almost always found that the eggs of fish and crustacea were round. The eggs of lobsters, tortoises, and turtles were all of this shape. Eggs of the common snake were oval.

The circulation was well seen, and some small excrescences were noticed on the body, but whether they were parasites or not was uncertain.

Various marine objects, including boze from Atlantic Cable, sponge spicules, young star fish, &c., were exhibited by Messrs. F. E. Sawyer, W. Puttick, R. Glaisyer, and the President, Mr. Haselwood.

Mr. W. **WONFOR** also exhibited one of Möller's "Diatomaceen typen plattes," lent by Mr. T. Curteis, of 244, Holborn, London, an honorary member of the Society. It consisted of eighty distinct species of diatoms, mounted in circles, with the name of each photographed below the circle, and the whole contained in one-eight of an inch square. The names could be read easily under a low power, while under higher powers the valves were as clean and as perfect as in all the specimens from the same mounting. It was indeed a marvel of manipulative skill and ingenuity.

JULY 2ND.

ANNUAL EXCURSION.

Groombridge, the place chosen for the 19th Annual Excursion, is a good-sized hamlet on the borders of Sussex and Kent, about four or five miles from Tunbridge Wells. To most persons it is chiefly known from the fact of its being a junction, and at first sight there would appear to be little of special interest in the neighbourhood for a Scientific Society, other than that which the natural beauty of the scenery affords. So thought many of the members, and questioned the expediency of such a comparatively uninteresting place being chosen for the Annual Excursion. At the close of the day, however, every one was agreed that a more enjoyable excursion could not have been spent. *The* feature was the charming variety it furnished, each of the spots visited affording new and attractive points of interest : first an old family mansion, with a dash of historical and antiquarian interest connected with it ; then reminiscences of African travels and exploits ; then a beautiful combination of the artistic and the picturesque such is not often met with..

The members and friends left Brighton by the 7.55 a.m. train, and arrived at Groombridge at half-past nine, where they were met by the Rev. B. Whitelock, M.A., the Curate, who kindly acted as cicerone during the greater part of the day, and who at once conducted them to "Groombridge Place," the historical residence of the Rev. J. J. Saint, the Rector of Speldhurst, and Lord of the Manor, by whom they were most hospitably entertained. "To partake of tea, coffee, &c.," was the invitation ; but the *et cetera* formed the most prominent feature in the halt for refreshment ; a repast, in which elegance was united to substantiality, being spread in the quaint old hall of the mansion, and the ladies of the family doing the honours of the table.

The repast completed, and grace having been sung by the Rev. J. H. Cross, Dr. King, and Mr. Dennant, from music composed by Mr. Cross during the journey by train, Mr. Saint gave his guests an account of the history attaching to Groombridge Place.

The present structure, a brick mansion with stone dressings, enclosed within a broad and deep moat, supplied with water from a stream flowing through the garden, was erected in 1660 by a Mr. John Packer, on the site of an old castle that originally belonged to William Russell, who came over from Normandy with William the Conqueror ; it was subsequently alienated, in 1405, to Thomas Waller, of Lamberhurst.

Here Charles, Duke of Orleans, one of the few lyrical poets of noble blood which France has produced, was detained a prisoner. The Duke was taken prisoner by Sir Richard Waller, the then proprietor of Groombridge Place, at the battle of Agincourt, who discovered him amongst a heap of slain. At first he refused both meat and drink, but was persuaded out of his resolution to starve himself to death by Henry V., who declined to accept ransom for him, and gave him into the custody of Waller. How long the Duke remained at Groomsbridge Place is uncertain, but he was subsequently removed to the Tower of London. When the Place was re-built by John Packer, a considerable portion of the panelling was used over again, and this is now to be seen in the Library—where some fine specimens of carved oak are to be found—and Dining Hall. One of the panels in the former room contains the arms of the Duke, and is unquestionably a memento of his confinement at Groombridge Place. Besides the carving and panelling, are some old paintings of previous Lords of the Manor, and a Bible, printed by Buck and Daniel, at Cambridge, in 1638, in excellent condition. The fire backs, too, in the rooms already spoken of are worth noting, both being in an excellent state of preservation ; one is dated 1579, the other 1604. Visitors to the grounds were struck with the peacocks, of which there were no less than 34, all of whom roost in the trees near the house. Having thanked Mr. and Mrs. Saint for their generous hospitality, through their President, the party next proceeded to Hillside, and from ancient, devoted themselves to subjects of modern interest.

Hillside is the recently-built residence of Mr. W. C. Oswell, F.R.G.S., the well-known African traveller, and stands at the top of a graceful eminence, about half-a-mile from Groombridge Place, commanding a magnificent view of Tunbridge Wells and the surrounding country. To obtain this alone was well worth the trouble of ascending the hill ; but when once inside the house, one forgot the beauty of its environs in the contemplation of the manifold treasures it contained. When written to by Mr. Wonfor, Mr. Oswell, whose modesty and retirement are proverbial, willingly offered to throw open his house to the members of the Society, but hinted that he did not think they would find much to interest them in it. How greatly he underrated, not only his unique collection of African trophies, but his own descriptive and colloquial powers, may be to some extent comprehended when it is stated that the visit to Hillside formed the most notable and interesting feature of the day's proceedings. Few, if, indeed, any, will ever forget either the anecdotes Mr Oswell told, or the charm with which he told them ; they could have been equalled, though scarcely surpassed, by one only—his old friend and companion Livingstone, in conjunction with whom he explored the southern portion of Africa, and discovered Lake Ngami. Avoiding publicity, and never referring to his exploits "save on compulsion," he on this occasion responded to the general wish and entered freely into his African experiences, which he described in a vivid and picturesque style, yet without the least approach to egotism or boasting. Mr. Oswell is, in fact, an excellent story-teller, putting his points well, and never becoming discursive. Not often, however, even to his immediate friends, is he so freely communicative as he was to the sympathetic audience who fully appreciated all that he had to tell them.

On entering the house, the visitor found himself surrounded by horns and skulls, which, Mr. Oswell said, represented the entire antelope tribe of Africa. In pointing out the peculiar characteristics of some of them, he drew particular attention to a pair of fine straight tapering horns, which, viewed from either side, obscured each other; he had not the least doubt that the animal which wore them, the oryx, was the fabulous unicorn. He also explained the feet of some kinds, showing that they were of great length where the land was swampy, and remarking that these antelopes were easily caught if driven to dry hard ground, being then tripped up by their own toes.

Showing the way into the drawing room, he pointed to a pair of horns which belonged to a red and white ox, that stood over six feet in height. The points of them were 8 feet 9 inches apart, but, measured round their entire length, for they were most beautifully and symmetrically curved, they measured 14 feet. Though he would not presume to talk of natural history in the presence of gentlemen so well up in the science as those present; yet he thought he might venture to relate a curious fact which he had never seen published. It was for that purpose he had directed attention to the horns of the ox before them. The oxen of which that one was a specimen were to be seen in large numbers in the lake districts, where he saw that one plunging his head down into the long succulent grass, and tearing it up by huge mouthfuls. It was a domesticated animal, and, having obtained possession of it, he started on his journey home with it; but the grass becoming shorter in length, the animal became less capable of getting food, as the horns prevented it from putting its mouth to the ground. The result was that it got daily thinner and weaker, and he at last killed it and cut off the head. But this was the curious point he wished to illustrate: When he and his party first came upon these oxen, the Kaffirs who were with him asked the Chief where he got such monsters? "Stole them from you," was the reply. "Never," said the Kaffir; "we never had anything of that kind." "Don't you remember the last foray," rejoined the Chief, "when we carried off your grandfather's cattle?" "Certainly we do," was the answer; and the Chief said, "Well, since they have been here they have grown like that." The peculiarity was, that the horns of all animals living upon the succulent grasses found by the lakes, grew to gigantic proportions, such as that before them; and, in reply to a question put to him, he added that this great change in these animals came about in less than 30 years!

Singular to relate, in one of the adjacent districts, and almost side by side with these magnificent beasts, were a small diminutive class of cattle, no larger than goats; indeed, he saw a goat on the Brighton Esplanade on the previous day which was a good hand higher. According to the natives these dwarf oxen were taken from a tribe at some distance; a party of slave dealers having first directed their attention to the fact of their being there and assisting them to capture them; the slavedealers securing as many of the wretched people as they could for their own vile purposes, and their native allies taking the herds of cattle as their share of the plunder. In reply to general queries as to how he discovered Lake Ngami, he told a story which may be briefly reproduced, though words would not convey a notion of the forcible style in which it was delivered. In company with Livingstone and several others, while endeavouring to find out the whereabouts of the Lake, they entirely ran out of water, and, after having suffered thirst for several days, he went out on a "voyage of discovery" to see if any was procurable. Suddenly the figure of a woman started up before him in the long grass. She, too, had been in search of water, and, failing this, was mashing up a sort of wild turnip, which is found in the locality, and which serves as a substitute for both meat and drink. Bushmen, indeed, would live three or four months upon it alone; and cattle would also thrive upon this and the bitter water melon, although no other food or drink were given them. In terror of her life the woman agreed to show them where water might be found, and led them through a quantity of timber, when suddenly they came upon a wide expanse; it appeared to be an illimitable stretch of water, but proved to be only an extensive "salt pan," about sixteen miles across. So powerful, however, was the effect of the sun upon the "pan"—ground over which a river or water had passed, leaving a brackish sediment—that it looked exactly like water at a distance. The real lake turned out to be 400 miles from this spot; and as to who saw it first, himself or Dr. Livingstone, he was quite unable to say.

The "tsetze," a small fly, not much larger than the common house-fly of this country, was not met till the tropics were passed, and was most destructive to the whole domesticated animal life. Two of them would destroy the largest ox. Its *habitat* was the bush, spreading only a few yards beyond it, and if cattle strayed into the bush the whole would be speedily destroyed ; that was, the cow, the ox, the horse, dog, or sheep ; but the donkey and buffalo it left unhurt. In fact, clinging to the haunches of the buffalo, it was spread only by that means, and would never be eradicated till the whole buffalo tribe was destroyed. He and poor Livingstone had been bitten all over with it, yet they never experienced any great ill effects.

"But," said a visitor, facetiously, "perhaps you were not domesticated then?" to which he, amidst laughter, replied, "That occurred in my wild days." As he had remarked, he had seen two of them kill an ox. It was not by a sting, he believed ; and he did not think it was by depositing an egg ; but the poison, or whatever it was, was communicated by the proboscis. Within a week after it was bitten the muscles and glands of the poor beast's throat would swell ; the hollows over the eye fill up ; the whole frame of the animal would become similarly affected, and in three weeks it would be dead, unless rain set in,—then it would be dead in ten days. He lost 24 oxen simply through the bite of the "tsetze."

"Is there no antidote to its bite?" was a question asked. "None that is known ;" "but there is one thing which I should mention as a still more curious fact. A calf when it is sucking may be bitten by the tsetze all day long ; but a weaned calf, when bitten, is dead in a week. But, as throughout the whole of nature, this fly has its enemies, being attacked by the ichneumon whilst on the wing, who sucks them dry and drops their empty shells in abundance."

In illustrating the ingenuity of the natives, he mentioned that Livingstone and himself had reached the bank of a very deep river, one of the feeders of the Zambesi, and were wondering how they should get their bullocks across, when, suddenly, a man appeared on the opposite side,—one who had never seen a white man before. Having induced him to come across in his boat, they consulted with him as to how the cattle could be got over. He went back, returning with a cow and a calf,—the cow in that part of the country being no larger than a Newfoundland dog,—and, landing the cow, took the cal back in his boat. The cow, after looking at the boat for an instant, took a header, and, plunging into the river, swam after her calf, pursued by the whole of the bullocks, which were thus got safely across. That was ingenuity on the part of the man; and he could give an illustration of extraordinary instinct on the part of the fishing eagle and other birds. He would not say that every time this fishing eagle put his wits into practice he was successful; but he would state that he lived by his wits. The eagle would watch the pelican fishing for his dinner, and, as soon as he had caught a fish in the large pouch of his bill, the eagle would swoop down towards him, when the pelican, if he was young and foolish, would look up and screech, and, whilst his mouth was thus open, the eagle would snatch the fish from it with his talons!

But the most striking instance of instinct that he had ever met with, and he had never seen a similar instance recorded in works on Natural History, was shown by the Toucan. One day he was standing by the river side, when Livingstone came to him and said, "What is the most striking instance of instinct and conjugal affection that you ever met with?" Being out of sorts about something, he replied, "Oh, bother instinct and conjugal affection too;" but poor Livingstone repeated his question and pressed him to come and look at what he had discovered in a neighbouring tree. "Look there!" he said, "what is that?" "A bird feeding its young ones, I suppose." "Aye," replied Livingstone; "the young ones are not only in there, but the mother too; and the father is feeding the whole family." The male bird was flying to and fro, collecting food which he was passing through a chink in the tree. It turned out that the female toucan had allowed herself to be plastered up in a hole in the tree, to be liberated only when the young ones were able to take care of themselves; and this was an instinctive precaution on the part of the parents to preserve them from wild cats, for, wherever the cats had been destroyed or driven away from around a native settlement, the toucan built as openly as any other bird.

The commencement of slaving operations in a district was next very ably described. Having promised to wait and watch for Livingstone, who had laid down to sleep one day, he fell asleep himself, and was awoke by a voice saying "I salute you." Casting his eyes up he saw a man standing over him dressed most fantastically in a red *robe de chambre;* and, bursting into a laugh, said, "Why, man, you look like a woman. Wherever did you get that dress from?" The reply was, "Well, I gave a woman for it." In conversation upon the subject, he ascertained that a man had been to the Chief and asked for slaves, showing him a quantity of clothes which he would give in exchange. Having taken several men and women prisoners in a late foray, the Chief gave these for the things shown him; when the man came again demanding more slaves. "He brought us this time," said the native, "such beautiful things, that you would have sold your mother." They had no men or women to sell, and, remarked the native, "to sell your children is an ugly thing." They refused to do this, whereupon the trader said, "You want cattle?" "We do," was the response; and "here (said Mr. Oswell) is the devilry of slavery." The slave-dealers said, "You help us to attack that tribe, and, as you want cattle, you can have the cattle and we will take the men." The bargain was struck, and the scheme successfully carried out.

Passing now into the Hall, he next proceeded to explain the habits and characteristics of the many trophies of his bravery and skill which were there exhibited. Here were the horns of almost every known kind of rhinoceros, buffalo, elephant, antelope, pallah, bok, koodoo, goat, &c., the whole of which had fallen under his deadly rifle. Among the rhinoceros horns was one curving downwards instead of upwards. These were very rare; he only met with five in the course of his travels.

Forming part of the same collection were a number of African weapons and other implements, amongst which was a novel pocket handkerchief. This was nothing more nor less than a piece of metal, about the size of a dessert knife-blade, with which the Kaffirs scoop the snuff from their noses after having taken it.

The next point of interest was the sitting room, where some twelve or fifteen sketches were hung, illustrating some of the principal scenes and incidents met with by Mr. Oswell during his travels. They were done in crayon, by Wolf, from Mr. Oswell's own sketches. These were viewed with more than ordinary interest, as several of them showed that he had experienced some really remarkable escapes of his life.

The first was a flat open piece of country, and he said that such was the characteristic feature of Africa for the first 800 miles; when the traveller came upon a mountainous piece, covered with dense forests; and in like manner every district had its distinctive feature. Africa was not a barren country: it was most luxuriant in vegetation, and was teeming with animal life; but the peculiarity of the country was that there were extraordinary lines of demarcation. On the opposite sides of a narrow strip of sand, only 20 or 30 yards in width, the vegetation would be found entirely different; so materially changed that the Kaffirs, who were excellent botanists and had an extensive knowledge of the use of plants, knew nothing of the productions which were found in passing from one district to another.

The vegetable and animal life in these districts were illustrated by the series of drawings alluded to. Pointing to a man and horse lifted from the ground, the rider flying through the air and the horse poised on the horn of a rhinoceros, one of the company asked if such an incident had actually occurred? "Yes," was the reply, "I saw it." "And who was the unfortunate man?" "Oh, that was my horse, the best in the world: I wouldn't have taken a thousand guineas for him the moment before that happened; but I avenged his death, and the horn of the brute that killed him you have seen in the hall." Being asked if the rider was hurt, he quietly replied, "I was stunned for the moment." There were two sketches of his being attacked by lions; one in which the animal had sprung upon the back of his horse. He had seen a cub running in the grass. It was only about the size of a puppy, and, giving chase to it, he heard the unmistakeable growl of the lioness, and rose in his stirrups to catch a sight of her, intending to dismount to shoot her, for it was waste of ammunition to shoot on horseback. He saw her charging after him, and clapped spurs to his horse to get away "when," said Mr Oswell, "I heard her paws go pat, pat, pat, upon the ground behind me, and at the third bound she was on the horse's haunches. Fortunately for me, she did not get forward enough to reach the saddle; but with her fore-claws fixed in the hind-quarters of the horse, her chin pressed firmly upon his back, and her hind-claws fixed in the thigh, she was carried along by the horse. Passing under a tree, one of the boughs caught me across the chest and rolled me and the lioness off together; when, snapping up my hat, she bounded off with it." "Then you escaped unhurt?" asked one of the company. "Not quite;" and, pointing to a scalp-wound, he showed where the bough of the tree stripped his scalp down over his ear.

That was the only instance, he said, of a lion attacking him in the day-time; adding that his experience of them convinced him that they were perfect cowards. In reply to a question as to whether they gave tongue when hunting, he remarked that the lion only gave utterance to two cries. They were a low soughing sound, one when he was in quest of food and the other when he was returning to his lair satisfied; they were similar, but easily distinguished on acquaintanceship with him.

In the corner stood the gun which served him in such good stead on many a critical occasion—a fine double-barrelled rifle, which Sir Samuel Baker borrowed of Mr. Oswell during one of his recent campaigns.

After partaking of refreshments the party left Hill-side for Glen Andred, the picturesque residence of Mr. E. W. Cooke, R.A., touching on their way the church at Groombridge, a small structure, built by Thomas Parker, the father of the gentleman who built Groombridge Place. In the churchyard is an ancient tree, which tradition says was planted by a despairing lover of Cecily Nevill, Duchess of York, afterwards mother of Richard III. In the church is a peculiar coincidence. Painted on the coloured glass are the arms of the Duke of Orleans already referred to, upon whom the Battle of Agincourt brought such disaster; and on one of the memorial slabs let into the wall is recorded the demise of the wife of Rear-Admiral Eardly-Wilmot, the present commander of the iron-clad Agincourt.

Mr. Cooke was sketching in the Isle of Wight; and as Miss Cooke was dangerously ill the party were unable to thoroughly inspect the wealth and beauty which is treasured up in the house. The lower rooms, however, were thrown open for their inspection, and all gladly availed themselves of the privilege of looking over Mr. Cooke's exceptionally choice and varied museum of articles of vertu, curiosities of all kinds, and his splendid collection of paintings in oil and water-colours. Time would permit of only a hasty stroll through the grounds, but it was sufficient to give some idea of their remarkable beauty and picturesqueness. They owe this to the masses of Tunbridge Wells sandstone, beautiful in themselves, but rendered far more beautiful by the artistic manner in which they had been surrounded by ferns and other plants.

Driving back to the station, the party devoted the remaining time to inspecting the collection of West African weapons and instruments belonging to the Rev. Benjamin Whitelock, whose residence overlooks the line. Most of these were brought from Ashantee by Mr. Whitelock's son-in-law, Captain Malin, who is secretary to the Governor of Sierra Leone; and sketches of which have appeared in the illustrated journals. At half-past four o'clock the party re-entered the train at Groombridge.

The return journey was broken at Lewes, where the party alighted and adjourned to the Star Hotel for dinner. The after-dinner proceedings were of a complimentary character, the manner in which the Society had been received by the Rev. Mr. Saint, Mr. Oswell, and the Rev. Mr. Whitelock being specially noticed in the speeches,—a vote of thanks being awarded them, as well as to Mr. Haselwood, the President, and to Messrs. Wonfor and Onions, the Honorary Secretaries. by whom the arrangements had been made and so ably carried out. The journey was resumed at ten minutes to nine o'clock, and Brighton reached at a quarter-past nine, everyone highly delighted with the very pleasant day which they had spent.

JULY 9TH.

ORDINARY MEETING.—MR. PANKHURST ON THE GEOLOGY OF DERBYSHIRE.

"When we looked on a Geological map and marked the many different tints which denoted the varied rocks of which our island was composed, we could the more readily understand the expression. "England is the paradise of the geologist." In no tract of ground of equal size on the globe was there presented such an epitome of the long life-history of the world as the fundamental rocks of our own island presented to us. Almost every tablet of the great stony record found here to a greater or less degree its representative. To be familiar with the names and character of all the multitudinous fossils which the strata disclosed, was possible only to a few; but it was given to all to take an intelligent interest in the rocks themselves; to learn something of the substances which composed them, of the manner in which they were formed, their relation to the scenery to which they lent a character, and their influence on the plants which covered them. It was in this respect that he appeared before them as a geologist, "to this extent, no more." And yet from such study, by no means profound or difficult, so large an amount of pleasure was to be derived that he was induced to lay before them the manner in which it contributed to make a fortnight's holiday at Easter as instructive as it was delightful.

Standing on some dominant point and noting the ridges of hills ending in a steep escarpment, and the multitudinous windings of the valleys at their base, the mind naturally inquired what forces had worked to sculpture the earth into this variety of form. The action of water immediately suggested itself. The streams trickled along the valleys, but the cause, if they were the cause, was out of all proportion to the effect. But the streams of to-day were but the ghosts of their former selves, and the hills but the degenerate successors of the primeval mountains. To solve the problem we must look to the action of larger and more impetuous rivers than our island afforded. He had represented on a diagram the lesson which Professor Ramsay said he learnt from studying the Moselle. A stream commenced its course on a high table-land; *a table-land higher than the present summits of Derbyshire hills.* In process of time it dug for itself a trench. The natural slope of the land would initiate the direction in which its waters acted with greatest effect. Gradually, a high bank would be formed on the side on which the land sloped. In its rebound it would wash with force and in process of long centuries the banks would eventually become the steep escarpments of the hills. The course of the Seine, near Rouen, was a splendid example of such action. But the manner in which a table land could be cut up into ridges by the action of streams was illustrated in the most remarkable manner he had ever seen by a rivulet which fell into the sea near Redcar, on the coast of Yorkshire. There, in miniature, was a table-land being cut up as it were before the eyes into the very forms of hill-sides, escarpments, and valleys, which on a grander scale he had been lately admiring in Derbyshire.

This was not what gave to the scenery of Derbyshire its peculiar characteristic. That which most struck the tourist, was the strange fantastic forms in which the rocks were worn. On the summits the stony crests of the hills were weathered into castellated turrets, honeycombed as if they were made of sugar or salt, instead of hard stone. On the slopes of the hills they were sculptured into strange and fantastic forms, tapering spire and minaret, huge towers, bastions, and buttresses of rock that imitated as it were the ideas of the mediæval architect. It was the same more or less in all hilly limestone districts.

Chemistry afforded us the clue to this. On a small scale he could imitate Nature with this bottle and test tubes. The rain falling through the atmosphere absorbed the carbonic acid gas which was always present there. The water, thus become acid by the presence of this gas in it, exerted a much greater solvent power on the rocks. Their softer parts yielded to it the more easily, the harder ones remained, constituting the varied forms of which he had spoken. The experiment would also illustrate the deposition of lime by the dropping wells which were among the curiosities of Matlock. As the carbonic acid evaporated, the stony matter which the water held in solution by virtue of the presence of the gas in it was precipitated. Thus the tufa was formed also, which constituted large beds in the neighbourhood of these streams of acidified water. Of such masses of water-deposited rock Rome itself was built. But the action of carbonic acid was one of the most potent forces at work in disintegrating the surface of the land. Filter, for instance, the mud from the waters of the Thames, and the limpid clear liquid that remained still held in solution a large quantity of matter dissolved in it. In this way that river carried down to the sea, according to Ramsay, 300,000 tons of carbonate of lime every year. Thirty million tons were thus dissolved out of the valley of the Thames every century by the chemical action of the stream.

A section of the High Tor at Matlock afforded a good example of the character of the mountain limestone in the neighbourhood. That the mountain limestone was of marine origin all were aware. The presence of corals, spirifers, terebratulæ, were abundant proof of this. But there were some peculiarities which were interesting. He had imagined that chert flints, for instance, were peculiar to the chalk. But, on the summit of the High Tor, was the familar face of the black flint nodules and the white chert. The silicious matter existed in the ocean beds of those primeval times as in the latter ones of our chalk. Before them on the table were some specimens of what the miners termed toad-stone. Its murky dismal colours, interspersed with spots, had doubtless acquired for it such a name, and yet it was the most interesting of this series of rocks. The curved lines of the strata in the High Tor told their tale of the enormous forces which upheaved and bent nearly double these vast masses of rock. Not the less had the toad-stone a history of its own, bearing witness to the intensity of the internal forces of the earth. It was the lava of an ancient volcano. Comparing it with a bit of modern lava, a porous mass, blown up into this form by the escaping steam and gases, it would be seen that in the toad-stone the holes were filled with a carbonate of lime. The molten mass was evidently poured out from the volcano on to dry land ; thus it became a porous lava, for steam and gases could easily escape from it. Again the surface of the earth sunk, the waters of the limy oceans covered it, and deposited in its interstices the white masses which gave it its singular spotted appearance. Such was the history of a piece of toad-stone.

The presence of the metals and their ores in veins through the rocks was still one of the most interesting and the profoundest subjects of geology. In how far heat, magnetism, electricity, &c., were concerned in producing ores, or in giving a direction to them, was still problematical. But what particularly struck him with regard to the metalliferous veins of Derbyshire was that they were all perpendicular to the horizon and obviously deposited in chinks of the rocks from a liquid solution containing them. They, as much as the carbonate of lime, were the results of infiltration. Take a mass of sulphate of barytes, which thus filled up a crack, and in the centre of the barytes were the glittering crystals of sulphide of lead. The rocks and metals of Derbyshire, which built up its limestone hills, were beautiful indeed, but not the less were they a subject of wonder, when they linked those solid masses in their ideas with the singular delicacy of the stems of the Encrinites which formed them, waving their feathery arms in countless myriads on the floor of the primeval ocean, and building with their remains the most romantic, the most lovely, of all our English hills. Between this Mountain Limestone and the coal-bearing strata, lay a vast series of sandstone rocks, in some places 1,000 feet thick. This yellowish sandstone capped the hills in the neighbourhood of Matlock, and stretched away in enormous masses towards the hilly district of the Peak. These limestone and sandstone hills were inferior to the Carboniferous strata, but all up through them Nature was, as it were, trying her 'prentice hand at producing the wealth of vegetation which followed. That limestone had in it masses of our black diamonds, strangely mixed with the glittering crystals of calcite.

The ripple marks on millstone grit told a tale of a shallow sea bed alternately dried by the sun and washed by muddy waters. The leaves and fronds which were plentifully interspersed in its layers, spoke of overhanging banks covered with the plants which found at last a resting place in its quiet waters. A vast inland sea perchance it was, the uplifted bed of which now stretched in almost unbroken line from Derbyshire to Northumberland. That ancient sea-bed, now lifted high into tors, fells, peaks, and moors, formed the "back-bone" of England; the great central water-shed from which flowed the streams on each side of it, either into the Irish Sea or German Ocean. Looking into the substance of the millstone grit, its small smooth fragments of rolled quartz, its glittering spangles of mica, with the felspar between all, told of vast mountains of granite, which must have been broken up in order to form it. Were the Cheviots once 60,000 feet high, as Ramsay told us the Scotch mountains were? or had the Cumberland hills lost some five miles in perpendicular height, as the Mendips had? He would not pretend to say; but, gazing at these enormous masses of sandstone, which must have been brought as sediment by in-pouring rivers and deposited along the bottom of some great sea, the mind was oppressed with a sense either of the vast forces which must have been once at work, or of the long eternities through which smaller ones must have persisted. Here imagination might find ample scope for its powers, and a "use" also which should be, in the best sense of the word, "scientific."

The **PRESIDENT** (Mr. Haselwood), in proposing a vote of thanks, said that personally he had felt deeply interested in the lecture, for in his youth he went over all the district on foot, seeing the wonderful rock, valleys, and everything, but he had not the scientific knowledge to appreciate it.

Mr. **WONFOR** said that Derbyshire was the first ground on which he studied the subject of geology; and on first looking at the place he was under the impression that he was looking at castles, towers, and ruins. On arriving he went out at night, and on going indoors expressed his intention of going to look at an old ruined abbey; but in the morning he found that what he had supposed to be ruins was castellated rock. As regarded the formation of tufa, which was still going on, it was much more rapid than people generally thought; and some of the arguments in favour of the great antiquity of certain cave deposits, left out of consideration the fact that drainage and cultivation had diverted the water bearing the stalactitic deposit; hence in those places the comparative modern slowness of deposit. The mountain limestone of Derbyshire, the chalk downs of Sussex, and the bed of the Atlantic Ocean all represented the same kind of organic formation, while the clefts in chalk corresponded with the caves of the mountain limestone.

Mr. HOWELL thought the so-called flint in one of the specimens produced was more like the chert which they met with in Sussex. Though not in his opinion flint, it helped to bear out the analogy traced by Mr. Wonfor.

The paper was illustrated by maps, drawings, photographs, and specimens, and by chemical experiments, showing the action of carbonic gas on lime, &c.

JULY 23RD.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON THE HAIRS OF CATERPILLARS.

If either works on the microscope or on entymology were consulted, very little, if any, information could be obtained on the hairs of caterpillars or larvæ, either as regarded their structure or the variety and beauty of their forms ; but here and there a few words might be found upon the urticating or stinging properties of the hairs of some caterpillars.

This urticating property was noticed in very early days, for according to Pliny,* the Cornelian law, *De Sicariis*, was extended to those persons who administered the hairs of the fir moth, *Cn. Pityocampa*, and which were supposed to be a very deleterious poison. Even when applied externally they occasioned a very intense degree of pain, itching, fever, and restlessness.

Occasionally allusion was made to other members of the same family, as possessing similar disagreeable effects, viz., *Cn. pinivora*, stone pine moth, and *Cn. processionea*, the processionary moth, the last named so called on account of the habits of the larvæ, when moving in the evening in search of their food. One caterpillar led the way, followed for some two feet by single caterpillars in Indian file, then came ranks in twos, succeeded, at about the same distance, by threes, fours, fives, &c., until the main body advanced twenty abreast, in so orderly and compact a manner that no human army could move with greater regularity or be more obedient to the word of command. As soon as the leading caterpillar stopped, the whole army halted; when he advanced, they advanced, until a fresh pasturage had been found, then they all dispersed, until some signal called them all together again.

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* Hist. Nat., I., xxxviii., cap. 9.

Woe betide the luckless individual who approached them while on the march, or incautiously handled them, for the tufts of short hairs, with which they were covered, possessed the power of producing an inflammatory irritation, worse even than the sting of a nettle. It is reported that in some cases, where persons have been stung severely, serious and sometimes fatal illnesses have resulted.

Not only when living, but even when dead, the hairs of this caterpillar possessed the same urticating properties. Thus Reamur, who had written a monograph on this moth, stated that he suffered, after handling the dead caterpillar, for days with an itching, in consequence of some of the short stiff hairs sticking in his skin, and being, at first, ignorant of the cause, and rubbing his eyes with his hands he brought on such a swelling of the eyelids that he could scarcely open them. Bonnet, too, who lifted some of these caterpillars from water in which they had been drowned, felt a numbness of the fingers, followed by an itching and burning sensation.

Fortunately or unfortunately, he had not come across this caterpillar, which abounded in France, and in 1865 was the cause of so much annoyance to promenaders in the neigbourhood of Paris that parts of the Bois de Boulogne were closed to prevent discomfort to those who incautiously approached the trees, where the larvæ were, so that he only knew the hairs from published drawings of them.

We had in this country several caterpillars, whose hairs produced the same or similar effects with some people, and as these hairs presented, microscopically, diversity of form he would specially direct attention to them. Among the most notable were *L. quercifolia*, the lappet; *O. Potatoria*, the drinker; *B. neustria*, the lackey; *B. quercus*, oak eggar; *E. lanestris*, small eggar; *O. pudibunda*, hop dog; *O. antiqua*, vapourer; *L. dispar*, the gipsy; *L. salicis*, the satin;

L. auriflua and *L. chrysorrhœa*, gold and brown tails; together with *C. caja*, and *C. villica*, the garden and the cream spot tiger. All these with some persons produced, when handled, either in the living or dead state, itching, inflammation, and swelling of the parts affected for days.

There was one very extraordinary fact connected with these hairs, viz., that while some were affected even if only the fingers touched the hairs, others could handle some with impunity, and could not come near others without experiencing discomfort. He had known cases where even the most careful handling of the brown tail had caused pain, and the person so affected, incautiously like Reamur, rubbing the face, could scarcely see out of his eyes for days after. When the hairs of this caterpillar were examined under the microscope the wonder ceased, as it would be seen they were admirably adapted to penetrate, whichever end touched the skin, while the jagged portion, barbed like an arrow, remained firmly fixed in the wound.

The typical form of hair among caterpillars was cylindrical and terminating in a sharp point; the hair itself being composed of the same chitonous substance as the skin of the animal, generally hollow and lined with a substance, which seemed to resemble *cutis*. Many, if not all, hairs, in the living state, contained fluid matter, possibly of the same nature as the circulatory fluid of the animal. Instead of springing from a bulb, as in mammals, the base of the hair was inserted in a socket, a ring-shaped projection, from which the hair easily parted company. Examples of simple hairs of this character might be obtained from the larvæ of the oak eggar and lappet, both of which irritated some persons. The larvæ in each case utilized their hairs in forming their cocoons, as was often painfully evident to some, when handling them. A member of his family could not touch a cocoon of the oak eggar, however old it might be, without annoyance, while he could handle them with impunity.

In the case of the garden tiger, hop dog, and some others, the hairs are deeply spinous from point to base. In the satin, sycamore tussock, and some others, the spines were thickly studded along the whole hair. In the case of the gipsy, the drinker, and the lackey, all of which, and especially the last named, punished some very severely, the hairs were very fine and beset throughout their length by very minute spines. In the brown tail, among longer spinous hairs, were immense numbers of very minute ones jointed throughout their length, and readily separating into barbs sharply pointed at one end and trifid at the other. These hairs parted from the caterpillar so readily that persons looking at them, while they were feeding, had felt annoyance, as though the mere movement of the caterpillar separated the hairs, which, like those of the processionary moth, were wafted by the wind. Some very peculiar hairs were found on the vapourer, knobbed and plumed at the end ; a similar, but more extensive, knob was seen on the hairs of a South American caterpillar. The hairs on the tortoiseshell and other Vanessidæ were very stout and jointed, while those from the white-plume moth caterpillar were imbricated and had somewhat the appearance of wool. Sufficient had been said to show there was such variety and beauty among caterpillar hairs as to recommend them to the notice of microscopists, who had simply studied, as far as he could gather, those from the larvæ of Dermestes and the pencil tail, which were well known as test objects of great beauty.

A question might arise—Whence the urticating power? In the hair alone, or some irritating substance within the hair? He inclined to the former, because hairs from cast skins kept for years, and from cocoons two or three years old, were equally urticating with those from a living caterpillar, as were also the hairs mingled with the webs spun by some of the sociable larvæ. He looked upon it as a merely mechanical action, similar to that produced by the hairs of the prickly pear, those from the interior of the fruit of the wild rose or *Cowage, Dolichos urens,* all of which were equally productive of irritation, inflammation, and feverishness.

To make out their structure caterpillar hairs should be mounted dry, in fluid and in balsam. Anyone turning his attention to them and not minding the risk of an occasional annoyance would be well rewarded for his *pains,* and possibly wonder why more attention had not been paid by microscopists to so interesting and instructive a class of objects. He could only account for the apparent neglect on the ground that few entomologists worked with the microscope, and that microscopists generally had thought the hairs of all caterpillars alike, whereas, as with the scales of the lepidoptera, so with the hairs of their larvæ, there was great variety of form and markings.

Finding so little said about them, and having, moreover, worked at them for some years, he considered the subject of sufficient interest to bring before the Society, with the hope that some members might be induced to carry it further than he had done at present, and to show to lepidopterists that there was much in the economy and physiology of their branch of study worthy of being critically examined.

Mr. WONFOR rendered the subject more attractive by availing himself of chalk and a black board in order the better to illustrate many of his remarks.

In the discussion that ensued, the PRESIDENT (Mr. Haselwood) asked, if the irritation caused by the hairs were merely mechanical, how it was that all persons were not equally affected by it? He suggested that the irritation could hardly be caused by mechanical action, but was rather the result of a poison communicated in a fluid state.

Mr. WONFOR, in support of his theory, that the pain was caused by the sharp point of the hair, repeated what he had stated with regard to the dried hairs found in old cocoons still retaining their urticating properties.

A suggestion having been made in support of the PRESIDENT'S view, to the effect that the dried fluid in the hairs of old cocoons might become liquified by the blood or even perspiration, Mr. Wonfor said the sting-nettle, the irritation caused by which was known to be a fluid, did not affect all alike; and he remembered also that he had experienced similar pains from the points of sponges, which had been boiled in acids and so thoroughly well-washed that it was almost impossible for any fluid to remain in them.

Regarding the destructiveness of caterpillars, Mr. C. F. DENNET alluded to the ravages which were made by one species among the cotton crops in the Southern States of America. He thought that Mr. Wonfor deserved great credit for the attention which he had given to a matter so interesting and important, though regarded as being otherwise by many people. In reply to this gentleman,

Mr. WONFOR subsequently explained that caterpillars changed their skin several times, and that they were devoured by certain birds, such as sparrows. A hint that the irritating properties of the hairs of these animals might be protective, was thrown out by the Chairman. Mr. Wonfor remarked that since, according to Kirby, small doses of the hairs might be beneficial in the case of intestinal worms, the caterpillars might serve as medicine to those birds which ate them. Anyhow the hairs were not protective against some birds, and other enemies of the caterpillars—the ichneumon fly, for instance.

As regarded the mechanical or fluid action of the hairs, it was considered by Mr. Scott that they should not call upon Mr. Wonfor to name some irritating fluid, when he had given so many irritating *points* (laughter).

Mr. **Wonfor** said that he should like some chemist to take charge of a few caterpillars in order to examine them, and ascertain whether or not there was an irritating fluid. He would certainly be rewarded for his *pains* (laughter). In reply to Mr. F. E. Sawyer, Mr. Wonfor explained that hairs came from off the body of the caterpillar without being touched.

The meeting then became a conversazione, when hairs of the caterpillars alluded to, with papers, and others, were exhibited by the President, Messrs. Wonfor, R. Glaisyer, Puttick, and F. E. Sawyer.

AUGUST 13TH.

ORDINARY MEETING.—MR. H. PRATT ON COGGIA'S COMET.

After referring to the early observation of comets, which had been found even in the Chinese annals ; to their almost infinite number,—Kepler declaring that the ocean was not fuller of fishes than the œther of comets ; and to the existence, as demonstrated by mathematical astronomy, of a connection between comets and the various meteor streams ; attention was drawn to the various theories as to the office of comets : namely, that they restored to the planets the electrical equilibrium which they, in turn, continually displaced ; that they might deluge a world with water or melt it with heat, or drive our earth from her orbit or set a star on fire.

None of these hypotheses had been established, and even the nomenclature of the comet was very imperfectly settled. There was an increased interest awaiting the visit of a comet, owing to the facilities which the spectroscope furnished for ascertaining their physical nature. The first application of the spectroscope to a comet was made by Mr. Huggins in 1866, and again in 1867 and 1868, but not of such a satisfactory character as to diminish the interest with which the announcement was received of the discovery, on the 17th of April, by a Marseilles observer (M. Coggia), of a comet, the orbit of which was determined by Mr. Hind, who was of opinion that the comet could not have visited our system for many centuries ; its curve was elliptical; the period of revolution of such length as to be uncertain ; the semi-axis major rather more than 430 times the earth's mean distance from the sun ; and the corresponding length of revolution nearly 9,000 years. By the 23rd June the comet became easily visible to the eye, with a tail of about one degree in length. On the 1st July the tail had increased to fully 1.5 degrees ; on 4th July to 3.5 degrees ; and on 6th July to five degrees, in two streams, divided by a darker space ; on 7th July to seven degrees. Stars were seen distinctly through the comet, and on the 7th a small star was easily seen through its brightest portion. On the 8th July the tail measured ten degrees, and the nucleus scintillated almost like a star, arising, perhaps, from unsteadiness in our own atmosphere. By 10th July the tail was more than ten degrees, and its sides were of equal brightness.

On the 14th July he observed the comet from Dr. Prince's Observatory, near Uckfield. Its tail was then between 25 and 26 degrees, and the whole comet much increased in brilliancy. The sector, in close contact wlth the nucleus, was only to be distinguished from it by the superior brilliancy of the planet-like disc, there being no dark space between the nucleus and the sector. The ends of the sector were deflected on each side, and connected by streaks of light with the tail; while parallel to these streaks and outside of them were others running towards the head, where they merged into a luminous hazy arc of light surrounding the sector at a short distance from it; and, as far as could been seen, unconnected with it. This arc of light was what was termed an envelope—and a conspicuous one. Behind the nucleus, and commencing close to it, was a dark space, in form symmetrical with the outline of the comet, and traceable for some distance ; it was suffused with a hazy luminosity and merged into the general undefined light of the tail. On the 14th July, when he saw the comet for the last time, its tail seemed to be fully thirty degrees long, and Mr. Hind had given its length on the 19th July as 43.5 degrees, or an actual length of 25,000,000 miles.

The spectroscopic analysis of its light was very important. On the 14th July, with the kind assistanee of Dr. Prince, he attached his automatic spectroscope to that gentleman's telescope, and was enabled to see the spectrum of the different portions of the comet near the nucleus, and to measure the position of the bands observed. The tail exhibited a faint continuous spectrum as a background, with two bright lines, or rather diffused bands, lying across it, each of them fading off more abruptly on the red side. He might have overlooked a third and fainter one, which had been seen by Dr. Huggins, but not by Mr. Christie, first assistant at Greenwich Observatory. Immediately noting the readings of the micrometer of his spectroscope for the position of the bands he had observed, he waited with some impatience to compare them with measures of lines of some of the elements. Several months previously, he had entered in his notebook measures of all the lines visible in the flame spectrum of carbon, and he now found two of these lines coincide with the brightest parts of the two bands of the comet's spectrum. The lines were situated, the one in the olive group half-way between D and E ; the other in the green group between E and F, and both occupied the second place in their respective groups, reckoning from the red end. This would give a high probability that the lines in the spectrum of the comet were due to the presence of carbon in the state of vapour, in agreement with the announcements of Messrs. Huggins, Secchi, and Christie. But it was important to keep in mind that greater certainty in the matter would be attainable could the comet's spectrum of bands be reduced to one of lines. Hitherto no one had announced that he had been able to do this. The spectrum of the coma was similar to that of the tail. The sector and the envelope gave spectra of a different order, being continuous, and suggesting the presence of incandescent solids, or the reflection of light from such.

The most conspicuous part of the comet's spectrum was that of the nucleus, which was bright and continuous, giving, as far as he could observe, no bright lines or bands. He saw it fade off gradually, but completely, before reaching the blue rays, and that at the red end there was a sudden diminution of its brightness, after which it could be traced for some distance, as if the red end was crossed by absorption bands, and that the light was too much weakened to render them clearly visible as bands. He placed the micrometer on the sudden beginning of the partially-absorbed rays, and at once saw it was close to D on the less refrangible side, and, in order to make assurance double sure, he passed the light from a candle through the spectroscope, and saw the bright sodium lines very near to the cross.

Subsequently, Mr. Christie, of the Greenwich Observatory, had announced his own observation of the partial covering up of the red end of the spectrum by absorption bands, and the distribution of similar ones over other parts of the continuous spectrum, but that he could not fix their position. D'Arrest and Huggins had also seen them. Mr. Lockyer remarked that the blue rays were absent. So the testimony of different astronomers respecting absorption bands in the spectrum of the nucleus amply confirmed what he observed under greater difficulties.

There were but few records as to the colour of the light of comets. Lockyer observed that the nucleus and head of their late visitor were orange-yellow. With different telescopes, he had noticed that the nucleus was a brilliant white, very slightly tinted with yellow, and the coma very delicately tinted with bluish-green. It appeared to him that the spectroscope was the best umpire in such matters. And it was well-attested that the brightest band of the spectrum of the coma was the green one, while the brightest part of the continuous spectrum of the nucleus was between the yellow and the green, from which one would infer a whitish light just tinted with yellow ; and, as the rays on the red side of D were absorbed, they should not expect the light of the combined rays remaining to be orange.

There yet remained unanswered a question of great interest. Was the light of comets their own light, or was it reflected from another source ? The first part was answered in the affirmative by the spectroscope, for, in respect of the band spectrum, doubtless its source must be in the comet itself. But as to the continuous spectrum the reply had yet to come. The polariscope, in the hands of Messrs. Huggins, Christie, Ranyard, and others, gave an unanimous verdict that a part of the comet's light was reflected light. Huggins had estimated its proportion at one-sixth. But reflected from what ? In connection with this question, Mr. Hind's recent remark was of great value. He had said that the impossibility of seeing the late comet by day, even in the most powerful telescopes, had afforded additional evidence that proximity to the earth is not so important a condition for visibility of a comet in the daytime as close approach to the sun, Two more comets had been discovered since that of Coggia, one of which was in our vicinity at the time of the solar eclipse on December 12th, 1871, and the outlines of which had been depicted, faintly but persistently, upon several photographs of that eclipse, taken at three different stations widely separated from each other. If, as there was every probability, this was a large comet between us and the sun—very near the latter, and making its presence known by stopping out a portion of the solar picture—then this was indeed one of the most remarkable discoveries in cometary history.

Mr. **DENNANT**, in moving a vote of thanks to Mr. Pratt, pointed out the benefit accruing from a gentleman devoting his attention to one particular branch of science.

The motion was seconded by Mr. W. M. **HOLLIS**, and carried by acclamation.

Mr. **PANKHURST** wished to know whether the growth of the comet, observed by Mr. Pratt, was a real one or not, and also whether the growth was continuous ?

Mr. **FRANCIS PHILLIPS** suggested that, as the parabola might be considered as a limiting form of the ellipse, it was just possible that those comets which are said to have parabolic orbits might really (like the planets) move in ellipses, but of such a form that they could not, from our present observations, be distinguished from parabolas.

Mr. B. **LOMAX** favoured the elliptical theory.

Mr. **PAYNE** said, if the movement was parabolic, the comets could not return.

Mr. **PHILLIPS** explained. The question he submitted was, whether the comets said to move in parabolas might not move in ellipses approximating to the parabolic form, in which case they would return, but after a time which might practically be considered infinite.

The Rev. J. H. **CROSS** thought, as it was evident that light was given from the comet, heat must also be given,—he considered, to a large amount.

Dr. **HALLIFAX** recollected that, at the appearance of the comet in 1811, the heat was unprecedented.

The Rev. J. H. **CROSS** pointed out that the carbon lines would indicate the probability of heat being given forth.

Mr. G. **Scott** thought that the nebulous condition of a comet, added to its gradual absorption, would lead to the conclusion that heat was given off.

In reply to Mr. Pankhurst, Mr. **Pratt** said the real diameter of the nucleus of the comet was 3,700 miles.

Mr. **Pankhurst** thought, then, that the comet being 430 times further distant from the earth than the sun, it could hardly affect the earth's atmosphere.

Mr. **Shelton** said, as it had been calculated that, before some comets returned to our system, 102,000 years must elapse, it showed that the ellipse must be a very eccentric one indeed. He thought comets' motions were greatly influenced by the planetary system.

Mr. **Payne** believed that the increased heat of a summer when a comet appeared was only supposititious, the recollection of a warm summer being impressed upon persons by the fact of a comet being visible in such year.

Mr. B. **Lomax** thought that almost everything was put down to comets. He had seen a severe frost attributed to one. (A laugh.)

Mr. **Pratt** quoted instances to show that the actinic influence of a comet was small, for it made scarcely any impression on a photographer's plate.

AUGUST 27TH.

MICROSCOPICAL MEETING.—"GNATS OR MOSQUITOS?" AN ENTOMOLOGICAL DISCUSSION.

An abstract of the previous meeting having been read, Mr. G. D. **Sawyer** related a circumstance which he noticed about forty years ago, viz., a wall in the Ditchling Road nearly covered with chrysalides.

Mr. T. W. **Wonfor** explained that it was familiar to entomologists that some caterpillars did select certain places in which to pass into the chrysalis state; and sometimes when they did so they were not in their natural condition, but were very often ichneumoned.

Mr. C. F. **Dennet** took occasion to pass a very high compliment upon Mr. Wonfor for the lucid way in which he had placed the hairs of caterpillars before the Society at their last meeting. He also incidentally referred to the fact of the paper having been reported, and mentioned that he had availed himself of this means to send a copy of it to a friend—an entomologist of no mean order—who had since cordially thanked him for calling his attention to a matter which had hitherto escaped his notice, but which had been dealt with in such an interesting and masterly style by Mr. Wonfor.

Mr. **WONFOR** then introduced the question, "Gnats or Mosquitos"—a subject which was creating some interest in London and elsewhere. That afternoon his wife read a paragraph in one of the papers about a visitation of mosquitos on Plumstead Marshes. In 1868, the good people of Plumstead Marshes, Woolwich, and Portsea, near Portsmouth, in a similar way cried out terribly about a visitation of mosquitos, and exactly the same misrepresentations concerning the visitors appeared in the public press then as now. He thought, under these circumstances, he might set some of those outside right in regard to the creature that had been stinging them. It was undoubtedly the English mosquito, and it was not a creature that had come over from the East Indies or South America, either in the egg or larval state, on the sails of ships. The life-history of the creature would prove that it was nothing more nor less than one of the twenty or twenty-five English gnats that we possessed.

The insect in the larval and chrysalis state lived in the water, and the only period of its life passed in the air was as the perfect insect, the gnat or the mosquito. They would, therefore, see how impossible it was for a mosquito of South America, spending nineteen-twentieths of its existence in the water, to come over in the larval state, on the sail of a ship, especially when it was stated that few gnats lived longer than a week. It seemed that, whenever we had a very hot summer, the bloodthirsty instinct of the female English gnat, or mosquito, was intensified, so that it was led to attack man with far greater vigour than in an ordinary summer. When they considered the millions of gnats that were to be seen flying over a large river just as they had escaped from the pupal state, it was not to be wondered at that such places as Plumstead Marshes and Portsea, having large expanses of water near them, should be largely visited by these insects. Specimens of the Plumstead or Portsea mosquito sent to him by friends were found to be identical with the *culex pipiens*, or ordinary English gnat. These insects could produce a shrill sound ; but he believed imagination often made people believe in its similarity to that of the American mosquito. They were capable of giving very intolerable pain, as one of his own family had experienced a few days since when at Dorking. An insect came flying in at his bedroom window, and he identified it as the cause of his annoyance. It was the same as the Portsea mosquito, identical with our English gnat, and nothing more nor less than the *culex pipiens*. The insect inserted its six or seven lancets into the flesh and pumped out the blood, thus causing the pain and irritation experienced from it. Fearing he should not be able to show them the seven lancets which each insect was said to possess, he had brought a specimen of the gadfly, or *tabanus*, which also had stinging properties.

The plumed antennæ and the scales of gnats were favourite objects with microscopists, these together with English gnats and so-called mosquitos from Portsea and Plumstead he would exhibit so that they might see they were indentical insects.

Dr. HALLIFAX mentioned that he had, that very day, been stung while writing by a gadfly, and that the puncture produced was for a time very painful. The insect which attacked him was of about the size of the common house fly, though of the same species as that which caused so much trouble to horses and cattle in the meadows. In reply to Dr. Hallifax, Mr. WONFOR said that the life history of the Indian mosquito and of the English gnat was the same ; the mosquito being to all intents and purposes a gnat. A case of recent mosquito stinging having been mentioned, and the pain having been described as severe, Mr. DENNET said it was a singular fact that, if the insect had been allowed to drink the blood to repletion, no pain would have been felt. Mr. G. D. SAWYER confirmed this statement, remarking that it seemed to be the driving away of the mosquito that caused it to sting.

Mr. WONFOR incidentally mentioned that the gnats or mosquitos did good, inasmuch as they purified the water in which they might be deposited by eating up garbage and decayed vegetable matter. Therefore while they found fault with them, they could not wonder at the enormous number of them in such places as Plumstead Marshes, the banks of the Mississippi, and the swamps of North America or the West Indies.

Mr. HENNAH then raised the question whether the irritation produced by mosquitos and such insects was caused by extraneous or other poison. As to the stinging properties of gnats, he thought it probable that the irritation they caused resulted from their lancets retaining and imparting poison received from their last meal. Flies which had been in a dissecting-room and afterwards bitten persons, had been known to cause gangrene of the part attacked. There was another thing, though not exactly microscopical, which he might then mention. It was the way in which the mosquitos were kept away from the dinner table in some districts of North America; blocks of ice were placed on the centre of the table and the mosquitos would not approach within a considerable distance of them.

It was suggested by Mr. LOMAX, that living as well as dead specimens of insects should be placed under the microscope at their meetings for the benefit of those members who had not microscopes of their own; but he was informed by Mr. Wonfor that live specimens had been shown two or three times, and would be again.

At the same time, it was observed by Mr. HENNAH, that living specimens could not be examined or even shown with advantage to members who did not previously know anything about them.

It was announced that Mr Brazenor had sent for distribution amongst the members :—The lower jaw of a rock python, the barb of a sting ray, scales of the armadillo, quills of the Brazilian porcupine, a skin of an English snake, and scales of the river crocodile.

The meeting then became a conversazione, when the President (Mr Haselwood), and Messrs. Wonfor and Sawyer exhibited objects illustrative of the discussion, including gnats, tabanus, and preparations of the organs of these insects.

LIST OF MEMBERS

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Brighton and Sussex Natural History Society,

SEPTEMBER, 1874.

Abbey, H.
Ardley, W.
Aylen, S.

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Beavan, J.
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Boxall, W. P.
Bright, E.
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Browne, G.
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Burrows, Sir J. Cordy
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Cross, Rev. J. H.
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Dawson, Dr.
Day, G. H.
Deane, W.
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Dowsett, A.

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Fowler, T.
Fox, O. A.
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Friend, D. B.

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Glaisyer, R.
Glaisyer, T.
Goss, H.
Griffith, Rev. Dr.
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Hadlow, F. V.
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Image, Rev. J.
Infield, H. J.
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Jackson, A. W.
Jackson, W.
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Jeffreys, W., Jun.

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Leuliette, L.
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Lomax, O'Bryen
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Malden, H. C.
Marshall, E. J.
Massy, Dr. Tuthill
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Moore, E.
Moseley, Rev. T.

Nash, George
Nash, W. H.
Nell, —
Newton, Rev. J.
Nicholls, W. H.
Nourse, W. E. C.

Onions, J. C.

Page, T.
Pankhurst, E. A.
Payne, F. W.
Payne, Rev. W. J.
Penley, M.
Phillips, B.
Phillips, F. B. W.
Pinker, H. R.
Pocock, C. J.
Pollard, T.
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Upperton, R., Jun.

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Verrall, Hugh

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Wallis, M.
Wallis, W. C.
Warden, E.
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Watson, W.
Wilkinson, W.
Willett, E. H.
Willett, H.
Williams, H. M.
Wills, James
Wilton, W.
Winter, J. N.
Wonfor, T. W.
Wood, J.
Wood, W. R.
Woodman, J.

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TREASURER'S ACCOUNT,

For the Year ending September 1st, 1874.

Dr.		£	s.	d.
To one year's Subscription to the Dispensary ...		2	2	0
" Ditto to the Ray Society		1	1	0
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" Contribution to the Medico-Chirurgical Society towards Expenses of Room		1	1	0
" Fire Insurance of Books to 25th March, 1875		1	2	0
" Printing,—				
Report and Abstract of Proceedings	£18 18 6			
Circulars, &c.	8 19 6			
		27	18	0
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" New Books and Periodicals		12	8	2
" Expenses of Soirée		26	15	1
" Sundries		0	5	7
" New Book Cases, Tablets, &c., fixed at the Free Library		29	13	6
" Balance		0	2	0
		£118	6	3

Cr.	£	s.	d.
By Balance from 1872-3	6	4	9
" Subscriptions in arrear on 1st September, 1873, since received...	6	10	0
" Subscriptions due on 1st September, 1874, since received	77	0	0
" Entrance Fees	15	0	0
" Received from Sale of Soirée Tickets ...	13	1	0
" Received from Sale of Annual Report ...	0	6	0
" Received Share of Profit from Insurance Office	0	4	6
	£118	6	3

Examined and found correct,—

GEO. D. SAWYER,
ROBERT GLAISYER, } Auditors.

September 7th, 1874.

THE TWENTY-SECOND

ANNUAL REPORT

AND

ABSTRACT OF PROCEEDINGS

OF THE

BRIGHTON AND SUSSEX

NATURAL HISTORY SOCIETY,

ADOPTED AT A MEETING HELD

THURSDAY, SEPTEMBER 9th, 1875.

PRICE ONE SHILLING AND SIXPENCE.

BRIGHTON:
PRINTED BY D. O'CONNOR, "GUARDIAN" OFFICE, 34, NORTH STREET.

1875.

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1875.

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MR. J. C. ONIONS,
56, Middle Street.

Honorary Librarian and Curator:

MR. ROBERT GLAISYER,
The Dispensary, Queen's Road.

At the Twenty-second Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, September 9th, 1875.

IT WAS RESOLVED,—

That the Report, Abstract of Proceedings, and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the cordial thanks of this Meeting be given to the Honorary Secretaries, Honorary Treasurer, and Honorary Librarian, for their labours in preparing the same.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Mr. Dennant; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. Benjamin Lomax, Mr. C. P. Smith, Mr. Dennet, Mr G. D. Sawyer, Mr Ernest H. Willett, and Mr. J. Wills. Honorary Secretaries: Mr. T. W. Wonfor and Mr. J. C. Onions; Honorary Librarian and Curator, Mr. R. Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian for their services during the past year.

SPECIAL BUSINESS.

That the following words be inserted in Rule 14 after the word "evening": "Except in the months of July and August, during which no meetings will be held;" and that in Rules 4 and 16 the word "October" be substituted for the word "September."

That the Committee appoint sub-Committees to undertake the several branches indicated in Mr. Wonfor's paper, read at the Ordinary Meeting on the 12th of August last.

(Signed) J. E. HASELWOOD,
Chairman.

IT WAS ALSO RESOLVED,—

That the warmest thanks of this Meeting be presented to Mr. Ald. Cox for his able conduct as President during the past year.

REPORT.

In presenting the Twenty-second Annual Report your Committee have the pleasure of recording the continued prosperity of the Society, which has considerably increased in number during the past year. They regret the loss which the Society has sustained by the death of two of its Members, viz., Mr. J. Howell and Mr. G. Scott, the latter one of the Vice-Presidents and Honorary Librarian, and who had for many years taken an active part in promoting the prosperity of the Society, and rendered valuable aid in obtaining the accommodation for the Society at the Free Library and Museum.

The state of the finances is very satisfactory. The sum of £2 10s. remains in the hands of the Treasurer, after expending £29 4s. 2d. in the purchase of new books and periodicals.

The following books have been presented to the Society during the year:— Eleventh Annual Report of the Belfast Naturalists' Field Club and Guide to Belfast (from the Society); Report and Proceedings of Eastbourne Natural History Society (from the Society); Journal of the Quekett Club (from the Society);

Annual Report and Proceedings of Maidstone and Mid-Kent Natural History, Microscopical, and Philosophical Society for 1875 (from the Society); Report of Lewes and East Sussex Natural History Society (from the Society); Quarterly Reports of Sub-Wealden Exploration (from the Secretary); Remarkable Forms of Animal Life on the Norwegian Coast, by G. O. Sars (from the Author); Sur les Brachiopodes Tertiares de Belgique, by T. Davidson, F.R.S., F.G.S. (from the Author); on the Trimerellidæ, by T. Davidson, F.R.S., F.G.S., and W. King (from the Authors); Geological Magazine (from Mr. H. Willett); The Glaciation of the Southern Part of the Lake District, and the Presidential Address before the Keswick Literary and Scientific Society, by J. Clifton Ward, F.G.S. (from the Author); On the Cephalopoda Bed and Oolite Sands at Dorset and Somerset, by J. Buckman, F.G.S. (from the Author); Flora of Eastbourne, by F. C. S. Roper, F.L.S., F.G.S. (from the Author); Proceedings of Geologists' Association (from the Society). From the Smithsonian Institution, Washington, U.S.A.: Report of the Society for 1873; Daily Bulletin of Weather Reports for October and November, 1872; Birds of the North West; Geological and Geographical Survey of Colorado; Geological Survey of Missouri, with Atlas; List of Elevations West of the Mississippi River; Cretaceous Flora of the Territories; Catalogue of the Publications of the United States Geological Survey of the Territories.

The following books have been purchased during the year :—Medical Botany, Woodville; Missionary Travels and Researches, Livingstone; Last Journals of Livingstone, by H. Waller, F.G.S.; Contributions to Solar Physics, Lockyer; Text Book of Botany, Sachs; Corals and Coral Islands, J. D. Dana; Log Book of a Fisherman and Geologist, F. Buckland; Insectivorous Plants, Darwin; Memoirs of Sir R. I. Murchison, Geikie; Climate and Time, Croll; Our Summer Migrants, Harting; Harvesting Ants and Trap-door Spiders, Appendix, Moggeridge; Mineralogy and Appendix, Dana; Cave Hunting, Boyd Dawkins; On the Microscope, Carpenter; Scottish Cryptogamic Flora, Greville; Episodes of Insect Life; Dictionary of Science, Brande and Cox; Heart of Africa, Schweinfurth.

Periodicals: Entomologist; Entomologists' Monthly Magazine; Geological Magazine; Grevillea; Linnean Society, Transactions of; Monthly Microscopical Journal; Popular Science Review; Quarterly Journal of Microscopical Science; Quarterly Journal of Science; Science Gossip; Zoologist.

The number of volumes in the Library is 858, exclusive of pamphlets and unbound current periodicals, and your Committee are pleased to learn that the circulation of books continues to increase.

A numbered Catalogue of the books belonging to the Society can be consulted at all times at the Library counter of the Free Library and Museum, and Members can obtain the Society's books on loan on application to the Assistant-Librarian during the hours the Institution is open.

Your Committee are pleased to hear that the public have made great use of the Society's books during the past year, and that the books have not received any damage at the hands of the public.

During the year the Society's Microscopical Cabinet, which now contains 257 slides, has received donations of slides from the following gentlemen: Mr. T. Curteis and Mr. T. W. Wonfor.

The Conversazione held in the month of February, 25th, at the Royal Pavilion, was very successful, both in the number of those who were present and in the variety and character of the entertainment. A detailed account will be found in the proceedings.

Scarcely any response having been made to the circular inviting assistance in verifying the fauna and flora of Sussex, as suggested in Mr. Wonfor's paper of April 10th, 1873, that gentleman read, on August 12th, this year, a second paper, in which he suggested a scheme by which the Society might accomplish that and other objects, and which your Committee hope will meet with your approval.

The thanks of the Society are due to those gentlemen who have read papers, exhibited objects, or presented slides for the cabinet, photographs and drawings for the Society's album, or specimens.

The Society is to be congratulated on the increased attendance at its meetings, the far greater accommodation afforded at the Free Library and Museum, and the growing interest taken by the Members in the welfare of the Society.

The Field Excursions since the last report have been as follows:—September, 1874, Cissbury; October, Falmer; May, 1875, Balcombe; June, West Grinstead (postponed in consequence of weather); July, Newhaven; August, West Grinstead.

The Annual Excursion took place on the 2nd August to Battle Abbey, and the Sub-Wealden Exploration at Netherfield.

In concluding their Report, your Committee beg to request the Members to endeavour to promote the prosperity of the Society by bringing its merits under the notice of their friends, by contributions of works of Natural History to the Library, of photographs or drawings of objects of Natural History for the album, and of slides for the Microscopical Cabinet, and particularly by Reading Papers during the ensuing year.

ABSTRACT OF PROCEEDINGS.

1874-5.

SEPTEMBER 10th.

ANNUAL MEETING.

The retiring President, Mr. J. E. HASELWOOD, before vacating the chair, said that as it was officially his "last dying speech and confession," he asked for their sympathy. First of all, he thanked very cordially the whole of the Members for the loyalty they had on all occasions manifested towards him, and for their attendance at the various meetings. During the year they had shifted from their old place of meeting into more comfortable quarters, and this, probably, had attracted more to their meetings.

Future years, he hoped, would find the number still increasing, for there could be no doubt that it was much more instructive and enjoyable when the attendances were large than when small.

With regard to the Committee, he was glad to be able to say that he had never been associated with a body of men between whom there existed a more kindly feeling. And this was equally the case with the Secretaries, from whom he had received the greatest assistance, and who worked together most amicably, their departments, the scientific and the business, never clashing the one with the other, or causing any jealousies to arise between them.

While speaking of the Secretaries, there was one point to which he should like to allude—the statement which was sometimes made (though it had never been made to him) as to the important and continuous part played by Mr. Wonfor in the affairs of the Society. It was said there was too much of Mr. Wonfor; and so, perhaps, there was in one sense. But this was the fault of the Members themselves; if they came forward and did their duty better than they had yet done, there would be no occasion for him to act as a stop-gap so often as he had to.

Knowing Mr. Wonfor, he was in a position to say that no man had less desire to monopolise the time of the meetings than he; he would only be too glad if the other Members came forward and took their share in the discussions, without falling back so much upon him. His position, however, was one which must always be recognised, for the greater portion of the burden of the Society fell upon his shoulders.

Those Members who, during his period of office, had contributed papers, he now took the opportunity of thanking; and he was pleased to notice that their efforts had not been confined to the comparatively small sphere embraced by the Society, but that, through the medium of the Press, they had been made known to the public, and had, he believed, in many cases, been extensively read.

With the Microscopical Members he was, perhaps, more at home than the others, and he would here hint to them the advisability of coming out with their instruments more than they did at the ordinary meetings. To some, perhaps, it might appear that the results obtained from the Society were not so great as they might be. But it should always be remembered that the majority of the Members, being engaged in professions or business, had not the necessary time at their command to devote to original research; all they were able to do was to make themselves in some measure acquainted with the labours of those who devoted the whole of their time to the advancement of particular studies. And in doing this they felt all the better, the habits which they thus acquired proving to be most useful in other walks of life; they were led to be studious, careful, and exact, and the possession of these qualities could not but be productive of good results.

But, it might be said, what had he for them in the shape of suggestions for the future. He had two suggestions. One was that papers should occasionally be read, dealing with the elementary aspect of the subjects of which they treat. Many of them, he was sure, oftentimes failed to appreciate some of the papers as much as they would like for the want of elementary knowledge respecting the particular questions referred to.

The other suggestion was that papers should also be read occasionally explaining the cant scientific terms now coming into use; such, for instance as "The conservation of energy," "The correlation of physical forces," "Natural selection," "The survival of the fittest," and "Evolution." Very frequently these terms were used as bugbears, for they were often used by persons in a very random and careless manner, showing that they were really ignorant of their true meaning. Let him, however, not be misunderstood; he did not wish to make these subjects of controversy —that would be unwise, and would sure to be productive of evil. On the other hand, papers explaining these terms, and showing in what sense they were used and understood by the master minds of the day would, he was quite convinced, be useful to them. Though the sphere of the society was small, he believed it had been, and would still continue to be, very useful to the town, helping to elevate some, at least, of its inhabitants into something higher than they would have been but for its influence.

It was with great pleasure that he vacated the chair in favour of such a man as Alderman Cox—one of the ex-Mayors of Brighton—who, he was sure, would preside over their gatherings in a manner which he had never been able to attain to.

The President, Mr. Alderman Cox, in taking the chair, said it was not usual, he was told, for the incoming President to make any remarks on first taking the chair; but he would take this opportunity of thanking them for the honour they had done him, and of saying that if he succeeded in performing the duties of his office as well as the President who had just retired from the chair, he should consider that he had performed them well.

Mr. M. **Penley** said he had been asked to propose that a warm vote of thanks be given to Mr. Haselwood for his able conduct as

President during the past year. He did so with the greatest possible pleasure. He had not been able to attend many of the meetings, but those that he had, had shown him how well qualified the ex-President was for the post he had held.

Mr. G. SCOTT seconded, observing that he had regarded Mr. Haselwood's performance of his duties with the utmost admiration; but this was only another instance of the manner in which the Society got through its labours under the presidency of the most varied men.

The meeting then resolved itself into an ordinary meeting for the exhibition of specimens.

Mr. G. SCOTT showed some interesting specimens which were about to be added to the Museum, including a March ichneumon (Egypt), an Alpine marmot (North Europe), a *Coati mondi* (South America), &c.; several rude flint implements which had recently been discovered in a new district—Pyecombe; and a ray from one of the fins of the gigantic sunfish recently caught by Mr. Lawler, of the Brighton Aquarium, off the Sussex Coast. Mr. Scott also exhibited a rough drawing of the fish, and explained its general characteristics. The fish was supposed to have been the largest caught in British waters. It weighed 12 cwt. Mr. Scott also showed a spine of the fish, measuring about 2½ feet long.

Mr. F. E. SAWYER showed a specimen of the *arundo arenaria*, obtained from the dunes in Holland, where it binds together the loose sand. Mr. Dennet made some remarks upon the subject, in the course of which he suggested the use of the *pinus maritimus* as a shrub suitable for sea-side gardening.

Mr. C. CLAYTON showed a good specimen of the jaws and paddle of an *ichthyosaurus*, brought from the blue lias formation at Street, Somersetshire.

Mr. WONFOR exhibited some Indian mosquitoes, as well as a small case of moths,—the Vapourer *O. Antiqua*,—the inmates of which had formed the subjects of a series of experiments on the attraction furnished to the males by the females of the species.

A long discussion followed this exhibition, the question being as to what particular sense enabled the males to discover the females when long distances intervened between them.

SEPTEMBER 24TH.

MICROSCOPICAL MEETING.—"POND LIFE."

Mr. T. W. **Wonfor** announced the receipt from Mr. Curties, of High Holborn, London,—who is an honorary member,—of a photograph of a group of thirty-five separate specimens of British microscopical animals and plants, collected from a pond at Leytonshire, near London, and drawn from life by Mr. H. C. Richter. The objects, which had been very beautifully grouped, were inspected with much interest; and the diagram, with the accompanying key, rendered the photographs more valuable. In the absence of Mr. Lomax, who had suggested the subject of the evening, but who was unfortunately prevented attending.

The President, Mr. Alderman Cox, asked Mr. Wonfor to introduce the subject for the evening.

Mr. **Wonfor** remarked that he had lately experienced the truth of an observation made at the last meeting that, although they might propose to show living objects, the difficulty would be to get them. Only the evening before he had some hundreds of specimens of the *volvox globator*, and he had purposed exhibiting the rolling, turning, volvox; but he was unable to do so as they had now disappeared.

A few bottles of specimens from ponds at Lewes and Furze hill, would, however, be submitted for examination; and he had also managed to secure some larvæ of the English gnat,—in other words, of a mosquito,—which would doubtless be looked upon with interest, remembering the discussion which took place at a previous meeting. The specimens of pond life would be likewise interesting, because of the anxiety manifested at times to know whether or not certain water was drinkable. Now, the mere fact of finding certain forms of animal life in water would not necessarily militate against it for drinking purposes; but if he found in stagnant or well water certain other forms of animal life, he should begin to inquire what it was that had filtrated into it.

There was before them a sample of water, taken from a well, to which, for drinking purposes, he should greatly object. There were in it forms of life of the kind invariably found in water into which some organic substance, or, in other words, sewage matter, was filtrating. That being so, and if sewage matter were there, he should not be surprised if, at some time or another, infectious disease broke out in the neighbourhood in which the water was consumed.

Certain forms of animal life were always to be found where the water was contaminated with sewage matter; in such cases there was always danger; and, consequently, important lessons were always to be drawn from examining the forms which the water contained. In reference to the water supplied by the Corporation of Brighton, there were circumstances connected with it which rendered it virtually impossible for it to contain organic life. It was brought up at such a depth from the chalk that, if examined microscopically when taken from the main, not a trace of organic life could be observed in it.

The **President**: Yes; and do not forget the fact that all the reservoirs have been covered over.

Mr. **Wonfor**: And, besides, it remained such a short time in the reservoirs after it had been brought up from the chalk. Examination had proved that the Brighton water was invariably free from any trace of organic impurity.

The **President**: Then you prefer the constant service to intermittent?

Mr. **Wonfor** replied that he had the constant service at his own house; and, in continuing, said if all could have their drinking water drawn direct from the main they would avoid the risk of having animal life introduced, by water standing in a cistern exposed more or less to the atmosphere. There were, however, certain forms of life in pure water which rendered it drinkable. For instance, the American weed, *anacharis*, having been thrown into water at Ditchling, never before drinkable, that water afterwards became pure and palatable, and was eagerly sought by those persons living in the neighbourhood.

Dr. **Hallifax** said it was acknowledged as a general principle that the growth of vegetables purified the water; and this was found to be the case even in tanks or globes, where the purity of either fresh or sea water was preserved by the presence of weeds.

The rapidity of growth of the *anacharis* weed was then dilated upon.

Mr. C. F. **Dennet** enquired whether there was no mineral substance pumped up with the Brighton water?

Mr. **Wonfor** replied that there was a quantity of chalk in solution—he believed about fifteen grains to the gallon.

Mr. **Glaisyer** said the proportion was about seven grains to the gallon, as supplied by the Corporation.

Mr. **Wonfor** observed that boiling would to a great extent get rid of the chalk; or, if the Brighton Corporation would adopt the plan which used to be a patent, but which was now public property, the quantity would be reduced to about three grains, the water would lose what was commonly called its hardness, there would be a wonderful saving to the ratepayers in soap, and to the householders in connection with their boilers and kitchen ranges.

Mr. **Dennet** handed in a newspaper paragraph which stated that Dr. Letheby had come to the conclusion that moderately hard water was safer and more healthy for drinking than soft water.

Mr. **Wonfor** remarked that, as a matter of fact, absolutely pure water was not good for drinking.

The meeting then resolved itself into a conversazione for the exhibition and inspection of the various objects of pond life which had been brought by Dr. Hallifax, Mr. Wonfor, Mr. J. E. Haselwood, Mr. T. Glaisyer, Mr. R. Glaisyer, and Mr. G. Nash. Among the most noticeable were the rotifera exhibited by Dr. Hallifax.

Mr. **Wonfor** specially drew the attention of the meeting to a specimen of the *Daphnia* which was covered with *Vorticellae*—small bell-like animals.

The larvæ of the English gnat, and specimens of impure well water containing *Bacteria*, were also shown.

October 8th.

ORDINARY MEETING.—MR. BENJAMIN LOMAX ON "FACTS IN THE CHEMISTRY OF PLANTS."

Although the chemical changes which the life history of every plant involved were discussed in most scientific works, and the number of organic compounds directly obtained from a vegetable source was recognised by all conversant with our manufactures, there remained an amount of chemical effect wrought on surrounding nature by the agency of plants which altogether escaped popular notice, and was apt to be under estimated even by the naturalist. He must leave to those who had better opportunities than himself the task of adding to their knowledge on this point, contenting himself with a reference to some facts with which all were acquainted, but few thought of in this connection, and trusting to the after discussion for further information. The evolution of oxygen by plants had been so exhaustively considered in botanical works that he should merely draw attention to the amount of work it actually represented. Every human being gave off, on an average, 154lbs. weight of pure carbon per annum. Assuming the population of the world at 20,000,000,000, the wonderful amount of 137 millions and a half of tons of carbon was expired from human lungs alone in one year. Add to this the carbon evolved from animals, large, small, and microscopic, the products of combustion, and the decomposition of organic matter, and some idea might be formed of the work which plants had to perform; and which they did so well that the amount of carbonic acid in the atmosphere was seldom, if ever, perceptibly increased.

The deposition of silica on the exterior surface of the culm in the cereals, sedges, and bamboo, might be, perhaps, regarded as necessary for the stability of the plant, but the geology of certain districts must be considerably modified by the change this formation indicated. Silica was usually found in a coarse, crystalline form, even the typical grain of sand having a very perceptible size and shape, whereas the siliceous coating of a wheaten straw was deposited in sufficient quantity to turn the edge of a knife, with a uniformity and a fineness of division resembling that produced by the electrotype process. Whether this silica was extracted from sand, as indicated by the constant presence of reeds and sedges on the sea shore, or separated from the soluble silicates everywhere present in arable soil, a curious chemical process must have taken place, which there was no means of tracing, and the question was not simplified but rather increased by the fact that the deposit was not always a powder. Frequently it was crystalline or needle-shaped, sometimes laminated, as at the nodes of bamboo, from whence it was collected in considerable quantity under the name of *tabasheer*.

Then, again, the importance of the change might be estimated by the scale on which deposition took place. The horsetails and reeds yielded in their ashes 97 per cent. of pure silica, the grasses nearly as much. The diatoms were almost made of silica, and when it was remembered that the deposit remained unchanged by burning or natural decomposition, it would readily be conceived that in this way also plants performed a most important work in nature. The silica so deposited was pure, and the purification of salts was one of the most remarkable functions of plants. In the laboratory, purification was generally performed by crystallising from a solution, and it was always assumed that a crystal possessing the proper form and colour was a pure specimen of the salt under examination.

In like manner plants produced various salts in purity, as those knew who were dicussing the beautiful crystals called raphides, found in the cells of almost all plants, but especially in the liliaceæ and kindred orders, with the crystals on the leaves of the deutzia, &c. In this pure form were found the carbonate, oxalate, phosphate, and sulphate of calcium, and those who were curious in the various shapes which crystals of the same compound assumed, might find fresh field for investigation in the fact that all the varieties of form common to the bodies mentioned were found in different plants, but that the same species always presented the same form and composition of crystal. Whether raphides were useful to plants or not, there could be little doubt that the continual separation, on so large a scale, of salts in their purest form, must have a very marked influence on the economy of nature.

Another strange function of plants was the suspension of odours, disagreeable or otherwise. A peculiarity which, in a less degree, was shared by other members of the goosefoot family, gave its specific name to the *chenopodium vulvaria*. Its leaves, when rubbed, imparted the disgusting odour of putrid salt fish, and superficial observers had regarded this plant as a contrivance for creating and diffusing a stench. But this was hardly the case. The stench was, he believed, antecedent to the plant. The *chenopodium* was found on the sea shore amongst decaying seaweed, or in heaps of rubbish, whence nasty smells might reasonably be expected to issue. The odour, which might otherwise have disgusted or poisoned the passer by, remained unnoticed when absorbed by the leaves, and it was not the fault of the goosefoot if we chose to handle and smell our fingers afterwards. During the exhibition of the local flora at the Brighton meeting of the British Association, one of these plants was kept alive for several days, and afterwards died in the same spot, and he could bear witness that no offensive smell was ever perceived, except by those who touched. The whole question of plant odours was an interesting one, as there seemed no rule or uniformity in them. Thus the *Viola odorata* and *Viola hirsuta*, the *Reseda odorata* and *Reseda lutea*, plants so similar as frequently to be mistaken for each other, differ essentially in this particular. The common *Diplotaxis* had a flower scented like the field *convolvulus*, while its leaves were simply disgusting. The *Silene inflata* had the taste and smell of young peas, while the *Poterium sanguisorba* smelt of cucumbers, and the *Lychnis vespertina* had a sweet odour in the twilight, and none by day.

Another peculiarity in plant economy was the power of emitting light. A common plant of Tasmania which had the form of a lettuce, and the pale, leathery appearance like that of a fungus, or liverwort, glowed at night with a phosphoric luminosity from every part of its surface. The children cut its leaves into fantastic forms and hung them in dark rooms. Though this plant was very abundant, he was unacquainted with its generic name, and did not know whether to assign it to the *Phœnogamia* or *Cryptogamia*, The light was bluish, like that of the English glowworm. The Australian glowworm shone with a copper coloured radiance. Similar phenomena had been regarded by Linnæus and others, as indicating an absorption, and subsequent radiation of diffused light, he might, without committing myself to this theory, point out a direction in which there seemed room for profitable investigation. There could be no doubt that light was largely utilized in vegetable economy. In the absence of light the decomposition of carbonic acid ceased. The juices of celery and endive changed their character, and colour was no longer produced. It appeared to him that we were justified in supposing that these functions were entirely discharged by light itself, and that the office of the plant was to expose the tissues under favourable circumstances. If this were so, an investigation of those conditions ought to enable us to make light do the same for us. As light produced all shades of colour in plants, a naturally coloured photograph was a possible production, and might be ultimately obtained, and as the character of certain juices was entirely changed by light, we might find out from plants the secret by which organic compounds, similar in composition, but different in properties and appearance, might be interchanged. It would be useless to refer to the countless organic compounds produced directly by plant organism; to starch, dextrine, mannite, gum, &c., &c. It was sufficient to remark that these substances were produced without any visible mechanism, and under circumstances apparently exactly similar, to show that in the simplest plant was locked up a secret of chemical manipulation to which at present we had not the slightest clue—but it was within the scope of his present object to point out as a great portion of plant work the conversion of gases into solid matter. Those who had grown mustard and cress upon a piece of wet flannel knew that a certain quantity of mould was produced. So, on a larger scale, every plant took its substance from the atmosphere and laid it finally on the soil, building up daily what would be cainozoic strata when we ourselves were fossils. The whole of our linen and canvas was thus woven out of thin air, for the flax plant, after the thread fibres had been removed from it, presented the same analysis as the soil from which it was taken.

At the request of the Chairman (Mr. Haselwood), a vote of thanks was awarded to Mr. Lomax for his instructive paper.

Mr. **Wonfor** remarked that, although they could not well separate chemical from physiological or life action, cases cropped up in which chemical action was seen to be produced without, apparently, the intervention of life. There was another curious fact, namely, that while on the one hand there was such a variety of colour produced by the action of light, the brightest sea weed was found in the deepest water, and in the darkest caves.

Mr. **Dowsett** added, the bright sea weed could not be grown in aquaria, unless the light reached it through a tinted medium.

The **Chairman** (Mr. Haselwood) thought this would form an argument to show that colour was not entirely due to light.

Mr. **Dowsett** mentioned another strange circumstance; that lemon, turpentine, and bergamot were chemically the same, yet emitted different odours. What produced the odours was unknown.

Mr. **Dennant** directed attention to one practical outcome, namely, the importance of instructing children in the elements of science. If, he said, the poor children of large towns knew ever so little of the importance of maintaining a balance between animal and vegetable life, their health would be much better than it was. If they would foster and nurture plants in their neighbourhood, they would be much happier and stronger than they were without any kind of foliage.

October 22nd.

MICROSCOPICAL MEETING. — "SECTIONS AND SECTION CUTTERS," BY DR. HALLIFAX.

The **Chairman** (Mr. J. E. Haselwood) read a letter from Mr. T. W. Wonfor, who had announced the subject, apologising for his absence through illness, and called upon Dr. Hallifax, who had consented to fill up the gap.

Dr. **Hallifax** said he much regretted the absence of Mr. Wonfor, who would have enlightened them upon the subject much more than he could. His object would be to give them a practical illustration—practical as far as possible—of cuttings for microscopes, and of all the instruments which they had at command, as well as the mode in which they were employed.

The first and most valuable cutting apparatus which he should bring before them was the instrument invented by Richard Beck, which possessed a very fine screw, having 43 turns to the inch, so that one revolution would lift it a 43rd part of an inch, and a fraction of a turn would obviously diminish the distance accordingly. The large head of the screw was so devised that it was divided into 25 parts, so that one was enabled to make a cutting by this machine of a thousandth part of an inch theoretically, and 500 parts of an inch practically. The plate, too, was remarkably true.

The instrument was invented for the purpose of cutting wood and sections of vegetable substances of a certain degree of hardness with a chisel. If, however, the subject were soft, a razor must be used, and for specimens of this nature he could not say Beck's invention was so valuable as it was for hard substances. He had fixed upon the surface of the machine a piece of plate glass, —the truest that he could procure,—to avoid friction and to allow the instrument used for cutting to pass over it more readily, an idea which would be found to be as correct in practice as it was in theory. There was another machine sold by Baker, of Holborn. The operation of the screw was the same, but it was not finished in the same neat and exact manner, so that it was impossible to get the same refinement in the sections produced by it. Mr. Haselwood, he believed, had also brought one of the most recent inventions, which had the advantage of a refrigerating apparatus.

Mr. **HASELWOOD** explained a section cutting machine known as Professor Rutherford's. This was provided with a refrigerator, which, being filled with ice and salt, solidified the wax or other substance in which the object cut was "mounted." The screw was a very fine one and was furnished with a spring, which would fix it at any part of its turnings. There was a difficulty of obtaining a proper section of very soft substances, such as animal tissue, but he believed the Germans were able to cut a section clean through a man's brain, a very difficult operation.

Dr. **Hallifax** said he believed the Germans possessed the secret of the means of obtaining such a section, which they did not promulgate to the world. The Germans cut such sections for sale, and did it on a very large scale.

Dr. **Hallifax** next showed the method of preparing soft objects for cutting, illustrating his remarks by producing a dead wasp, already attached to the cylinder by a mixture of gum and creosote, which he recommended as a preservative of like specimens, as the creosote remedied the brittleness of the gum. Wrapping a strip of paper round the cylinder so that the top edge of the paper was about on a level with the wasp, he poured melted white wax into this readily made capsule, completely submerging the body of the insect. When cooled, the wax held the body firmly, a cutting of the soft body being thus safely made. He also showed another similar apparatus, the "well" of which, however, was surrounded by a glass plate, the smoothness of which obviated, as far as possible, friction with the cutting instrument, which he advised should be moistened with methylated spirit. He mentioned that another mode of cutting was to place the object in the hand, and there was, too, a knife with two blades for cutting purposes, having a screw by which the two blades were brought together.

Mr. **Haselwood** pointed out that there was a newer invention —a knife with three blades, so that two sections, showing the contiguity of the parts, might be cut at the same time.

Dr. **Hallifax** then said that, in order to procure an accurate specimen of a minute section, it was necessary to have one side of the razor ground perfectly flat so that it might come in direct opposition with the object, and not scoop the object and thus destroy the specimen.

Mr. **Haselwood** observed that it had been recommended that the 1s army razor should be used, on account of its thin blade.

It was suggested by a member that the Plantagenet razor was very useful for such a purpose.

Mr. **Haselwood** further informed the meeting that, with the use of a new medical instrument, and the ether spray, medical men were enabled to take from the body pieces of diseased skin, so that they might study the various forms of skin disease.

Dr. **Hallifax** next exhibited a saucer arranged to facilitate the placing of cuttings on slides. Very thin sections, if placed in water, and the slides placed under them and then raised, rarely retained the desired position. To obviate this he had a small hole drilled in the bottom of the saucer, which was tightly fitted with a slip of wood. After the object had been floated into its right position, the plug was removed, and the water, running gently away, left the section in its proper place. The drilled hole should not, however, be too large, otherwise a current would be formed and destroy the effect of its operation.

At the conclusion of the meeting, the Chairman announced that the next microscopical meeting was the last of the series this year, and it was hoped that they would have a microscopical conversazione, and that members would bring with them the choicest specimens of their collection.

November 12th.

ORDINARY MEETING.—"ON RECENT EXCAVATIONS AT CISSBURY," BY MR. ERNEST WILLETT.

Mr. Wonfor had informed them that excavations had been made at Cissbury during the past summer: indeed, several of the members had themselves visited the spot; and, on the understanding that a more detailed account would not be unacceptable to the Brighton and Sussex Natural History Society, he had arranged a few notes on the subject into the form of a paper, for the defects and shortcomings of which he must ask their indulgence. Had the site of the work been other than at Cissbury, it would have been desirable to have preceded the paper with a description of the locality and situation of the earthwork, but the spot must be so familiar to every Sussex man who was interested in ethnology, and the camp had been so frequently described that, in the absence of fresh information bearing on the subject, it would be inexpedient to recapitulate minutely the accounts given by the various archæological authorities who had treated on the subject. The etymology of the name had, too, been a wide field for speculation. Camden in the 16th century, Cartwright, Turner, M. A. Lower in this, had discussed the question at length, but the result of their several and combined efforts was, he was afraid, eminently unsatisfactory. They all attributed it to the "bury" (or fort) of a Saxon General, of whose occupation of the camp, or presence within its walls, from internally derived evidence, we had no proof whatever. He could not accept the theory, in the absence of all traces possible of Saxon tenancy; it might be supposed that had the hill been occupied by a military chief (sufficiently powerful and well known to give his name to the place) some relics would have been found in the numerous excavations that had been carried on in and about Cissbury, of so highly a civilized people as the Anglo-Saxons. This was the case with the Romans, who, though they were by far more advanced in the culture of arts and manufactures and manners of living than our German forefathers, were but temporarily established in this country, of them we had sufficient evidence in bones, pottery, coins, &c., to believe that, if indeed they were not the actual engineers of the Camp, they selected it as an important post, and held it for some time. With this brief introduction he would proceed at once to the subject more properly before them, hoping, though far from being sanguine, that future excavations might reveal a Saxon burial ground, or that a derivation supported by more patent external evidence might be found by some one in an unlooked for source. He proposed to divide his paper into three parts:—

I. To give a description of the pit, the galleries connected with it, and the material with which they were filled in.

II. To state the reason for which it appeared the pit and galleries were made, and to describe the various manufactured articles found, their occurrence and probable uses.

III. To compare the workings with those of similar character in other parts of the country, and to shortly consider the question as to who the people were who originated them.

It was difficult, even if it were desirable, to prevent these three questions overlapping and running one into the other, as they were so intimately connected one with the other.

The pit was rather at the south extremity of the series of basin-shaped hollows which occupied the south-west corner of the camp. He had no especial reason for selecting this one in particular, except that it appeared not to have been previously disturbed; it was of an average size, and the depression from the natural slope of the hill was very slight, only about 16 degrees.

The result of the excavation showed:—First, surface soil, similar to that in all on this side of the camp, containing chipped flints, flakes, and broken implements, land and oyster shells, numerous water-worn pebbles, a few pieces of bone, and fragments of a coarse pottery. Below this, to a total depth of five feet, came a layer of small chalk, rubble, and loam, of a yellowish colour, containing a few flint implements, one or two fragments of bone, and a deposit of charcoal surrounded by calcined chalk. This stratum seemed to extend beyond the area of the shaft in north, south, and westerly directions, and was the layer from which Col. Lane Fox, in his extensive excavations in 1872, obtained the greater number of the flint implements on which he founded his able treatise, read before the Society of Antiquaries. Dead land shells also occurred in this layer, of which by far the greater portion were *Cyclostoma Elegans*; but specimens of *Helix nemoralis*, and one of the rare shell *H. obvoluta* (now almost extinct in Sussex), were also found. At five feet (the depth at which the solid chalk at the edge of the pit commenced) the filling-in entirely altered, being composed of a moist red earth, full of flints worked and unworked, numberless chippings, a fragment or two of stags' horns, and several patches of charcoal. This feruginous deposit was much thicker in the centre than at the sides; it seemed much trodden and worn, the implements were mostly huddled together at the centre, but unworked or merely broken flints occurred all through the layer.

At 10 feet it was replaced by large blocks of pure chalk (in some cases roughly squared) loosely thrown in, the interstices not filled up by looser or smaller material. No change was observable for about three feet, but here, viz., at 13 feet, came a repetition of the red earth above mentioned, with the same characteristics, but not so thick as the one above, two feet being the greatest depth at the centre and thinning out to six inches towards the circumference, and this did not extend to the sides by 18in. The remainder of the *debris, i.e.*, from 16 feet to the bottom, was pure chalk, but it differed from the layer above in that the blocks, though loosely thrown in, had their interstices filled with small chalk, rubble and loam. Throughout this layer were distributed the implements, which would hereafter be more fully described, and with which he concluded the original sinking was done. They consisted for the most part of the broken pieces of the antlers of the red deer, showing more or less marks of usage and manufacture, four scapulæ (shoulder blades) of *bos longifrons*, and one of the common pig, one or two flint implements, and a few broken flints. The thickness of the last deposit made up a total of 20ft. from the ground, and which was tabulated as follows:—

Surface soil 2ft., chalk rubble 3ft., red earth, &c., 5ft., chalk blocks 3ft., red earth, &c., 3ft., chalk blocks 4ft., total 20ft. At a depth of 17ft. from the surface in the north-west corner he, not altogether unexpectedly, came upon the mouth of a cave. He said not altogether unexpectedly, because he had previously seen similar caves in another pit in the camp, though on a much smaller scale. And as the workmen proceeded, one by one were displayed to view the series of eight caves, which constituted the chief interest in their work. These caves, as could be seen by the ground plan, ran laterally in all directions, and were filled before the excavation to within from 1ft. to 2ft. from the top with loose blocks of chalk partly converted into a kind of stalagmite by being cemented together by carbonate of lime, derived from the percolation of rainwater through the chalk above; it was exceedingly hard, and required a considerable blow to detach the pieces which it was necessary to remove, but this hardness was not so observable at the entrances, and from the mouth, running in a few feet, there was distributed some red earth, containing a few pieces of bone and an implement or two. The caverns were of an irregular height, owing to the roof giving way more in some places than in others, but the variation was from three to five feet; the width of each was undetermined, as in some instances the separation from one another was merely effected by a barrier of this stalagmite, and had it been considered safe to remove this they would probably have found that, with the exception of a block of chalk left here and there for support to the roof, the whole series was, in fact, very nearly one large cave, with several openings. This was not the case in every instance, and where they were enabled to measure, from side to side, the width of the actual chamber was about 4ft.

Cave No. 1 was explored to a length of 19ft., at which the solid chalk was not reached, for the wall there was still composed of blocks of stalagmite, and on placing a lighted candle to a chink the effect of a strong draught was observed. Now, on the surface, at a distance of 20ft., there was an indication of another shaft, from which he thought it was but natural to conclude that they communicated one with another. A similar case occurred in No. 6 cave, but there an unimportant difference was observed, for in this instance they did clear the pit to the solid wall, and a squared aperture of a few inches was found. If this communicated with another open shaft (as it was reasonable to suppose was the case), it was somewhat strange that it was so small as to preclude the interchange of anything except words or very little articles between people stationed on either side. Part of a layer of undisturbed flint, of an exceedingly fine quality, lay at the bottom of the galleries, and several detached pieces occurred all through the filling up of the caves. Another layer of an inferior quality was to be seen in the west side of the shaft, at a depth of 10ft., and two vertical veins cut through the pit, one running N.W. and S.E., the other nearly due E. and W.; the latter dipped to the south, at an angle of 63 degrees.

Commencing the second division of the subject, various had been the suggestions as to the purpose for which these galleries had been made. A very natural theory, and which seemed to present itself first to the mind was, that they were dwelling places, or at least caves of refuge, if not for the whole year, at least for seasons when the winter storms would render the rude wattle huts but a poor shelter against the inclement weather; or when harassed by war, the tribe in possession might have a safe retreat for the women and children. He did not say that this might not have been a secondary purpose to which they might have been applied, but he deemed it highly improbable primarily that for either of these purposes they would have gone so deep; and secondly that, had they done so, that a people even so barbaric as these inhabitants must have been, should not have left some traces in pottery, charcoal, remains of bones, of a continued habitation. Another suggestion was that they were storage barns for grain, and what valuables they became possessed of, but if so why should the shafts be filled up again so carefully? And how was the entire absence of anything of the sort accounted for? A friend of his from Cambridge suggested that they had been used as smugglers' caves; but this supposition could not, he thought, be maintained. Another explanation must be sought, and he was fully convinced, in his own mind, that the main purpose in view by the original excavators of the shaft and galleries "was to obtain a supply of the flint which occurred at this depth, for the manufacture of the implements found so abundant on and immediately under the turf, and of which so many cartloads of chippings could be obtained at Cissbury." This theory was not his own, it was suggested nearly two years ago by Canon Greenwell, who had said for some time that in his opinion these workings would be discovered, if only one went deep enough. He at first received it with great incredulity, and for a long time was not convinced, but as the evidence which he hoped to adduce was gradually revealed, he could no longer hold out against it.

The first objection which was urged by everyone unacquainted with corroborative evidence, was, "Why should they go so deep for flint when they could get it on the surface?" To this was answered that the flint was much softer and more easily worked when freshly procured than when it had been dehydrated and weathered by exposure, and further, this had been so often proved that, at the manufactory of gun flints, which was still carried on at the little town of Brandon, in Suffolk, they procure their raw material at a considerable depth. Thus much for the suggestion. Did the internal evidence support it? Yes, he thought eminently it did. In the bottom of cave 6, as before mentioned, existed, only partially worked out, a layer of fine soft flint which must have extended over the whole surface occupied by the base of the shaft and caves. In this layer was observed a small hole in which a flint had once rested *in situ*, and from which it had been extracted, and from the numerous minute chippings still in the bed, it was evident that it was chiselled out. The caves ran in the same line as the layer of flint, and on the same level, and were filled up just as one would expect them to be if this theory was acceptable, *i.e.*, in each cave by the loose blocks that had been detached in working out one of the others, which would naturally be thrown in when the mineral was exhausted, rather than be dragged to the surface.

He must, incidentally, mention a curious fact noticed, viz., the occurrence, not exactly, but nearly, in the centre of the base of the open shaft, of a small cutting, one foot deep and wide, and two feet long; it was filled by chalk loam, and there was not a trace of charcoal, or of discoloured chalk, which might have indicated the presence of a fire. It had been suggested that it might have been an experiment to see if another layer did not immediately underlie the one that had been worked out, and, finding this not to be the case, no further use was made of it. He could account for it in no other way. Turning to the various manufactured articles found (consisting mainly of flint implements and bones), and their occurrence and appearances, it would be observed by looking at the diagram, that the character of the deposit below the level of the original chalk surface, was divided into four distinct strata, two of red earth and two of blocks of chalk. As to the relation of the traces of man's presence with one and the other, it might be roughly stated that the worked flints occurred in the red earth, and the bones were associated with the chalk; this was not absolutely correct, as there were several minor instances *au contraire*, but it was substantially so.

Taking the bones first, then, they were represented by pieces of the antlers of the red deer, variously manipulated. There were in all, the fragments of about ten, more or less, in a poor state of preservation, much broken, and therefore not showing so plainly their original shape as some that had been found elsewhere. There was only one fair example of that, of which he hoped to find several, viz., the instruments with which we might fancy the excavation was principally carried on; this was the antler stripped of all its tines, except the brow tine, which thus formed both a powerful pick, and, when reversed, a hammer, and was, in fact, the prototype of the implement (in wood and iron), at present in use for the same purpose at Brandon. It measured 11in., and, though broken, it was evidently a new tool, as it did not show those marks of the workman's hands which were so plainly visible on similar tools found in other localities, to any extent, the only marks of manufacture being that the brow ridge had been jagged off. Next this was the remains of a tool manufactured from the top end of an antler; in this an attempt had been made to sever it by cutting, but it had been abandoned, possibly a mark of impatient snapping. The handle in this specimen was much worn, but it was difficult to determine whether it had been intended for a pick or a drill; perhaps both, more probably the latter, as it was unusual to find the picks made from the cup end. Then there were the tines, which, broken off as they were to enable them to use the pick more comfortably, became in themselves useful implements. An example of their use occurred in cave 6, for, in the entrance, there was a block of chalk partly detached, and the hole bored evidently by a tine, to prize the block down, was still apparent.

In the pit opened by Mr Tyndall in January, a horn was found with all the tines broken off, and a hole in the thickest part for the insertion of a celt; this form, common enough among prehistoric nations, having been found in the Swiss lake dwellings, and elsewhere, did not occur in his pit, though at 15ft. they found a very perfectly fashioned celt, which might have been from one of these tools, the handle being broken. Associated with these picks were the fragments of five scapulæ, for the identification of which as *bos longifrons* and pig, he was indebted to the kindness of Professor Flower, F.R.S., of the College of Surgeons. Their occurrence with the picks, and the absence of any other bones, was most singular, and he had suggested that they might have been shovels, which idea was favoured by the scratchings on them, and by the fact that in three cases out of the four the large anterior spine had been cut down; they were very remarkable, and we had good reason for believing that these bones had not before been found under the same conditions, and evidently for these uses. He could hardly apply the same remarks to the smaller one, though its occurrence alone was curious.

The next things which claimed attention were the flint implements, and if they were in any way inferior in importance to the bones in point of rarity, they made up this deficiency by their abundance. Colonel Fox, in the second of the exhaustive and admirable papers on the Sussex Hill forts, entered into a long dissertation on the Cissbury implements, and divided them into about 15 different types, which were massed into two groups, and sub-divided into about 25, as might be seen by reference to the before-named paper. He had for simplicity's sake, divided these into six groups. Of these 90 stones, he looked upon few as finished weapons, regarded from an external point of view, but considered that many were finished as far as the purpose for which they were intended to be applied, as for instance, the wedges and hammer stones would not be considered as typical specimens of neolithic stone art, but when one looked at the two opposite, namely, the pointed and battered ends of the wedge, and face of the hammer stone, it was seen how useful they could be in the hands of a people to whom the use of iron was unknown, in detaching blocks of chalk. Forty-five (or nearly one half the whole amount) were rough unfinished cores, *i.e.*, flints which had been worked more or less, but which did not show, from secondary chipping, any marks of completion or usage; and these must be looked upon either as having been found unfit to be manufactured, by some flaw in the grain of the flint, or, from the incompetence on the part of the workman, to have been cast aside as spoilt material, rather than to be archaic types of hatchets or axes of palæolithic forms.

Then came the wedges to which reference had been made and the correlative hammers. Of scraper-like objects, *i.e.*, stones with one side flat and the other levelled up to it by small chippings, there were seven. One was made of a very curious flint indeed. There were in all twelve celts, mostly of the common wide type, broader at one end than the other. Of their use we could only speculate, as he was not aware of any of the shape ever having been found affixed to a handle; they occurred with one or two exceptions at eight feet. Of the used flakes two were very good, being worked into the form of knives, and showed evidence of their use in that capacity, for which they were well adapted.

So much had been previously written on the character of the Cissbury flints by Colonel Fox, Dr Stevens, and others, that he should not refer to them at more length than simply to say that, whilst at work in August, he obtained several good implements from the surface soil round about the mouth of the pit, some, indeed, in a high state of finish. Several plainly exhibit Steenstrupp markings. One thing of interest that turned up was a piece of hard quartzite, and which had one of its sides polished by friction. This was highly important, in that its presence suggested that the few pieces of polished stone, which had been found in and about the camp from time to time, had been ground on the spot, and not, as had been suggested, that the chipped flints were polished elsewhere; though he certainly should be glad to see more extensive proofs that this was the case by the presence of a grinder's shop among the many chipping places that were still left on Cissbury. It was also worthy of remark that with reference to the dehydration, oxidation, or separation of the silica of the flint, or whatever it was that caused the alteration of colour to flints exposed on or near the surface on chalk soil, that in the first few feet all were so patinated to the depth, varying from the thickness of a sheet of paper to an eighth of an inch, and that the lower down the shaft they found them the less they were whitened. For instance, those occurring in the red earth deposit at eight feet were no more than just discoloured, whilst the few found at 15 feet, and below, were as fresh as the day they were fashioned from the natural sponge. All the stones, however, in the red earth deposits were covered instead with a crust of carbonate of lime which was easily detached by water and scraping. It was curious that the analysis of the two colours of flint had shown no appreciable difference in degree of silica and lime, as it was only in chalk districts that this was observed, the implements of the drift type and others found on sandy soils retaining their original colour to a high degree. This dehydration took place on the upper surface.

As to the occurrence of these remains at the various levels, the first two feet presented such appearances as one would expect to find in other parts of the camp. The chalk rubble deposit also extended over the part of the camp beyond the area of the shaft, and was not remarkable for much, except that it contained charcoal and flint implements. But when they came to the red earth deposits, they had two very marked periods of the temporary cessation of the filling in of the shaft; they both presented such characters as one would expect to find if these levels were occupied as flint workshops by the tribe who had sunk the shaft after they had nearly or completely worked out the flint and partly filled it in. They were, in the first place, trough-shaped, deeper in the centre than at the sides, and the material appeared to be much trodden; fragments of charcoal were observed, and very numerous in both cases were the rough flints, chippings, and fabricated tools. In the case of the lower stratum this was further evidenced,—that all around the sides of the shaft at this level (viz., 12 feet) were to be seen marks of abrasion and weathering in the chalk, pitted over with small holes or weather markings.

In brief, the entire case (so far as reasoning from circumstantial evidence was safe) appeared to be this:—1. The neolithic tribe who held Cissbury might have excavated the shaft till they came to the layer of flint; this they worked out to the extent of the area of the shaft, and, having found by experiment, or being aware from former experience, that another layer was not to be met with for some distance, they drove headings in all directions into the chalk, and worked out the layer horizontally to a certain distance, leaving here and there a pillar to support the roof. 2. That these galleries were driven one after another, and not all at the same time, for it would not be worth while to lift the detached blocks to the top; and it seems that, when they had raised all the flint they could in one direction, they filled the first gallery with the *débris* from a second.

He had already remarked on the probable conjunction of two or more pits; this would be naturally advantageous for communication to those at the base of two approximate shafts, and one was surprised to find the apertures not larger. When they had worked out the flint around one shaft as far as they considered it safe, they sank another, and threw the output of the second shaft into the first. The implements which had been used and broken in one place would naturally be left at the bottom, it not being worth while to carry such away. He could account for the red earth flint implement deposits by supposing that, when the shafts were partially filled up with blocks of chalk, they presented a very favourable place of retreat as workshops during bad weather. It was much less exposed, and a certain amount of flint might have been left from the galleries in the shaft for this purpose, "thus laying up flint for a rainy day." Then, in process of time, it became necessary to do something with the large accumulation of chalk on the surface, and, it might be supposed that it was thrown into an open pit, thereby raising its level again, which might again be used as a protection by the workmen who, though less sheltered than when deeper, would have less climbing and descent in getting to their posts. There were no steps cut in the sides such as would admit of being used for ascent, but this would hardly be necessary, as a rude kind of ladder made of a tree, with its branches cut off about a foot from their conjunction with the trunk, would answer the purpose, and, moreover, could be removed from one shaft to another, as occasion required.

It now remained but to compare these workings with those found in other parts of the country, and then to consider what conclusion, as to any date that may be assigned to their use, may be safely arrived at from the evidence before them. Grime's Graves, near Brandon, explored by Canon Greenwell, of which a full account appeared in the *Ethnological Journal* of January, 1871, Buckenham and Eaton in Norfolk, Crayford and Dartford in Kent, the Spiennes workings in Belgium, and the Penpits in Wiltshire. Time would allow him to refer only to the first of these. Considering the similarities and differences between the Grime's Graves workings and the Cissbury pit, the former were found so numerous and the latter so unimportant, that if additional evidence was wanting to support the "Flint working theory at Cissbury," there would be overwhelming testimony. There were the workings, which were in full swing some thirty centuries ago, still carried on, and it was a most interesting example of how natural features, assisted by tradition, might afford the same employment to succeeding generations in one locality. The flint at Grime's Graves lay rather deeper than at Cissbury, being 39ft. from the surface, instead of 20, though at Brandon, distant only about a mile to the south-west, this same layer came much nearer the surface, but it was not there quite of such good quality. The means of reaching and raising it were the same, viz., sinking shafts at irregular distances, and driving headings laterally, though the shaft, which was opened by Mr Greenwell, was found to decrease in width from 28ft. to 12ft., instead of being perpendicular. A layer of inferior flint, called in Suffolk "wall flint" (for its unfitness for flint knapping and therefore used for building purposes), was met with in both cases, that at Grime's Graves being 7½ft. above the floor flint; that at Cissbury 10ft. The galleries at Grime's Graves seemed to be driven more in straight lines than at Cissbury, and the connection between the pits effected by larger openings. One most remarkable occurrence was met with at the end of the first gallery at Grime's Graves, 21ft. from the mouth, for the account of which he quoted Canon Greenwell's own words:—

"The roof had given way about the middle of the gallery and blocked up the whole width of it to the roof. On removing this, and when the end came in view, it was seen that the flint had been worked out in three places at the end, forming three hollows extending beyond the chalk face at the end of the gallery. In front of two of these hollows were laid two picks, the handle of each towards the mouth of the gallery, the tines pointing towards each other, showing in all probability that they had been used respectively by a right and a left handed man. The day's work over, the men had laid down each his tool ready for the next day's work; meanwhile the roof had fallen in and the picks had never been recovered. I learnt from the workmen that it would not have been safe to excavate further in that direction, the chalk at the point being broken up by cracks so as to prevent the roof from standing firm. It was a most impressive sight, and one never to be forgotten, to look, after a lapse, it may be, of 3,000 years, upon a piece of work unfinished, with the tools of the workmen still lying where they had been placed so many centuries ago. Between the picks was the skull of a bird, but none of the other bones. These two picks, as was the case with many of those found elsewhere, had upon them an incrustation of chalk, the surface of which bore the impression of the workmen's fingers, the print of the skin being most apparent. This had been caused by the chalk, with which the workmen's hands became coated, being transferred to the handle of the pick."

The shaft itself seemed to be filled up at Cissbury with the *débris* from another, or even from several, but was not arranged in definite layers. It varied much from chalk to sand, but at no depth were the changes sufficiently distinct to measure. It was remarkable that no pottery was found in either case, for though their pit did not appear ever to have even been used as a receptacle for refuse other than chalk and flint, the one opened by Mr. Tyndall in January last, to which there were no galleries attached, contained a great quantity of bones which appeared to be the remains of animals used as food; in this there was also no pottery. As to the animal remains, the excavating tools made from stag's horn were far more numerous in Norfolk. In all, Canon Greenwell found 79 picks, some very perfect, showing marks of usage, by the well-worn handles, more plainly than any obtained at Cissbury. But when other organic relics were examined the principal difference between the two places were seen. At Grime's Graves the bones were entirely from domesticated animals—*Bos Longifrons*, goat, sheep, pig, and dog—from which, and the fact that the majority of the horns of the red deer there found were shed, it was argued that the race had passed beyond the hunting stage and was verging on the agricultural; a few fragments of a broken statue carved in chalk also occurred. The Cissbury bones, such as had been found, were nearly all feral. *Bos Primigenius*, otter, and stag were represented. The two skulls of urus which Mr Tyndall obtained were as large as any ever found, and it was also the first time the progenitor of the Chillingham cattle had been found in connection with neolithic remains in the South of England. Then, in conclusion, there was the question who were the people who made these shafts, and when did they live? and Mr Greenwell had written so clear a statement of his reasoning thereon, that he could not do better than read it, as it seemed as applicable to Cissbury as well as to the locality for which it was written.

"There had been only two periods during which flint of the quality found there has been quarried as extensively as these workings imply. One is the age when stone was the material used in the fabrication of weapons and cutting implements; the other and much later one, when it was used in the manufacture of gun-flints. It is evident that the latter period was not that when these pits were excavated; for the animal remains alone point to an earlier one, without taking into consideration the fact that, since the invention of fire-arms, flint and chalk have never been quarried by other tools than those of iron. There remains, then, the period during which stone was used for weapons and implements. This period, no doubt, was to a certain extent contemporary with the age when bronze was also in use for certain articles. But before that time a pure stone age had prevailed, when no metal, except perhaps gold, was known. To this early period, the Neolithic, I think these extensive workings must be referred. The quantity of flint that has been obtained from the pits (at Grime's Graves) is so great, and the supply of material for implements was so very large, that it is difficult to understand how operations on a scale so extensive could have been required when the use of stone must have been to a great extent superseded by metal. During the time when both stone and metal were in use, flint was required more for smaller weapons, such as arrow points, and for articles like scrapers, saws, and knives, than for larger implements such as hatchets. The perforated stone axes, which were no doubt in use together with bronze, are never made of flint. We may regard these workings, then, as belonging to the neolithic age, when metal was unknown, but when the grinding and polishing of stone was understood. The palæolithic age, when flint was most extensively used in the same district, cannot have been that of the working of these pits; for, apart from the fact that nearly all the drift implements have been made from surface flints, and those generally not belonging to flint of the quality obtained at Grime's Graves, the greater part of the animal remains found in the pit do not belong to the fauna of the drift, nor were any bones of the most characteristic animals of that period discovered there. (This last sentence must be somewhat modified when applied to Cissbury, as some of the implements found are similar in shape to recognised palæolithic tools, and the urus also belongs to the drift fauna.) The time occupied in working the whole series of pits and galleries must necessarily have been a long one; for, even with a large population, such extensive operations could not have been undertaken in a short period. There could scarcely, however, have been a large population settled in the locality; for such could not have been supported—the supply of game, large though that may have been, being quite inadequate to afford food for more than a people of limited number, and pasturage for domesticated animals being very scanty and poor. The evidence supplied by the pits themselves very strongly supports the view that a long period of time must have been occupied in quarrying the flint. A single pit, with its galleries, would afford stone sufficient for the manufacture of thousands of implements, even allowing for a most lavish and wasteful expenditure; and when it is considered that the pits number about 250, some idea may be formed of the enormous quantity of implements which must have been supplied by the (Grime's Graves) workings alone. There is, however, good reason for believing that this series of workings is only one out of many others (in the same district), and if such is the case, imagination almost fails to conceive the vastness of the supply of material for the people of the stone age provided by the chalk of Norfolk. But flint was worked by means of pits in other chalk bearing counties, besides being obtained on the surface, and in the shape of rolled pebble on the sea beach ; so that we have to add many other sources of supply to that of Grime's Graves and other Norfolk workings. Taking these facts into consideration, we seem to require a very extended period for the neolithic age itself, as well as for the time during which the pits in question were in operation. We have no certain factor, however, at present, by which to measure that period."

This is what Mr Greenwell said, and he was inclined to agree with him in the main points, and believed we had yet no notion of the vast extent of flint working that must have gone on in the different countries where chalk occurred, and of which fresh evidence would turn up in future years. The evidence already deduced from observations at both places pointed to a very wide range in time for their duration, and we had in addition at Cissbury three other factors, two at the commencement and one at the end, to add on to the accumulated era. The two carrying us back being 1st—The occurrence of *Bos Urus*, which was an animal belonging to the drift fauna; 2nd, the presence of feral animals, showing that the people were still not advanced beyond the hunting stage; and 3rd, we had the invasion of the Romans associated with our British Camp, bringing us forward to historic times. One question he had omitted, *i.e.*, whether the pits were coeval, older, or more recent than the vallum and ditch. He had done this purposely, as he hoped at some future time to open one of the pits situate without the camp, and he preferred to wait to see what it had to say on the subject, and what points of similarity it had to this, before venturing to enter on this topic. Before sitting down he had two duties to perform :—First to acknowledge the great kindness and courtesy of Major Wisden, the owner of Cissbury, for the facilities he had afforded him in carrying on this work; it was also through his generosity that he had, on the part of his father, to announce that evening the presentation to the Museum (as soon as means were forthcoming to properly display them) of the whole of the relics of human workmanship from the pit; secondly, to state that many thanks were also due to his friend Canon Greenwell, of Durham, for the valuable suggestions he had from time to time supplied him, and for the kind permission he had given him freely to use and refer to his valuable paper on Grime's Graves. If he could answer a question on any point that he had not made sufficiently clear he should be very happy to do so to the best of his ability, and he must thank them for their patient and courteous attention.

The **President** (Mr Alderman Cox) said he thought he should but express the opinion of everyone in the room if he said that the paper which Mr. Ernest Willett had read had been of very great interest, and that their best thanks were due to him. The trouble taken in the preparation of the paper must have been very considerable; and he proposed that the best thanks of the society be tendered to Mr Willett.

Mr. T. W. **Wonfor** thought it the general opinion of those present that Mr Willett need not have apologised for the paper he had brought before them. The essay was a most exhaustive one, and it had, he thought, satisfactorily cleared up the point as to what was the meaning of these pits and galleries. A good many had been much puzzled on the subject; but the evidence which Mr Willett had adduced, put side by side with that of Canon Greenwell, unmistakeably pointed to the pits having been primarily—whatever might have been their secondary or subsequent uses—for the purpose of obtaining the flint necessary to the manufacture of flint implements. One point had especially struck him. A few weeks ago, certain members of the society were looking over some of the pits at Cissbury, and they came upon pieces of partly worked flint when turning over the surface soil. It had been now explained that the pits were partially filled up and then used as workshops for making the implements. Some had laughingly said that it was all very well to try and make them believe that the flint was used in the manufacture of implements; and that the flint was of such a character that it would not bear working. Doubtless, however, the flint found near the surface was that which had been discarded as useless. Others had argued that they were merely natural flakes. The piece of sandstone which Mr Willett had produced bearing a smooth surface was, he thought, one of the most satisfactory results of the exploration; as it had evidently been used for grinding purposes.

Mr. **Willett**: And it must have come a distance of many hundreds of miles; as there is no stone of the kind near.

Mr. **Wonfor**, continuing, said another extraordinary thing was the fact that the entrance into one of the pits was found to be square. Dr. Livingstone had called attention to the fact that the natives of Africa could not build square, and the circumstance that these pits were partly constructed square seemed to bear out the idea that the people using them must have been highly civilized, while the indication of the presence of feral, rather than domestic, animals seemed to tend in an opposite direction. Then came the other point, namely, that Mr. Tyndall's pit was found to be a kind of charnel house, in which were strewn bones and what not. Perhaps, other pits might reveal similar things; and it might be found that, instead of these being the bones of feral animals, the people used domestic cattle as well. He believed the bones of domestic animals were found by Col. Lane Fox?

Mr. **Willett**: On the surface soil only.

Mr. **Wonfor** hoped they would be able to prove at some time or other that the pits were the finishing places, and not merely places where the materials were roughly hewn and then taken elsewhere for completion as implements. He looked forward with much interest to this point being cleared up. The experience of Mr. Willett at Cissbury, coupled with what was discovered at Grime's Graves, was, he thought, most satisfactory evidence of what the pits were primarily used for; though they might, secondarily, have been used as places of refuge. He felt much indebted to Mr. Willett for his paper.

Mr. **Willett** said he should very much have liked Mr Tyndall to have been present, either to support him or to hear what he had to say on the subject. Mr. Tyndall's pit was very much deeper (30 ft.) than his (Mr. Willett's): but it was not attached to any galleries; nor did the layer of flint extend to this pit. Whether flint was distributed over the whole area he did not know. Anyhow, flint was not found there; and, therefore, the pit might have been used for throwing in what was found. Mr. Tyndall had some splendid bones, which were excavated from the pit, including some large heads of extinct animals.

Mr. **Bigge** enquired what was the primary object of this "station?" The idea of some was that it was a military camp. Mr. Willett's idea was that it was a sort of Birmingham for the manufacture of flint implements. Why did they manufacture flints in such enormous quantities there when, if they went on to the sea shore, the flints might be picked out from the escarpments of chalk *in situ* instead of burrowing down in the way stated? Was there anything particular in order to bring the people there? Was the place a camp, and did the people do these things while in winter quarters?

The **President**: I understand that there was a peculiar kind of flint.

Mr. **Willett** said he apprehended that the camp was much later than this flint implement work, the camp being under the Romans.

Mr. **Bigge**: Then, did the people live there; or else, why go there to get that which they might have obtained much easier, as one would think, elsewhere?

Mr. **Willett** supposed the people occupied the hills—they did not know. There were times, as were believed, when the valleys round about Cissbury were navigable and uninhabitable, and so the hills were selected for refuge.

Mr. **Bigge**: Were there any holes beyond the camp?

Mr. **Willett**: Many pits existed on the outside of the camp.

Mr. **Bigge** supposed the camp to be Roman?

Mr. **Willett** thought British, and under Roman occupation.

Mr. **Wonfor** pointed out, with regard to the remarks of Mr. Bigge, that, although the chalk cliffs might now be easy of access, in pre-historic times large masses of water intervened, and it was then easier to obtain the flint from the pits.

The **President** said the natural shape of the hill ran almost smooth, and there was a distinct vallum and ditch. Did Mr. Willett suppose that the vallum was raised at a later period?

Mr. WILLETT said he had not examined a pit outside the camp; and could not say.

The PRESIDENT: Merely, from the natural shape of the ground, it did not appear that there was sufficient earth dug out from the ditch to form the vallum.

Mr. WILLETT: They may have done that to find the pits.

Mr. C. F. DENNET: How did they account for there being no sort of cooking utensil in the pits? They must have had something for cooking their food.

Mr. WILLETT: Their cooking material was charcoal. The only utensil found had been a piece of chalk. Mr Tyndall, in his pit, found a piece of chalk, excavated like a cup; and in the Grime's Graves four such cups were found. These were supposed to have been used as floating lamps. It would have been perfectly impossible to work in the pits without some light; and the people might have used large pieces of chalk for pots; but none such were found, nor of other pottery.

Mr. C. F. DENNET, as one of the members of the society who visited the pit, thought the people must have had some rule or plummet by which they worked by measure, the walls being quite smooth. It still puzzled him that, in the excavations of Mr. Willett and Canon Greenwell, no utensils had been found that could have been used for eating or drinking.

Mr. WILLETT said Mr. Tyndall, in his pit, found about four pieces of chalk, bell-shaped, with a hole bored through the top; but he (Mr. Willett) could not tell what they were for.

Mr G. SCOTT thought they would not be likely to find cooking utensils in a chalk pit.

Mr. WILLETT mentioned that no barrows were found at Cissbury or its neighbourhood. The people must have had chiefs—at least there was no reason to believe otherwise—but no British barrows had been found.

Mr. G. **Scott** had not known that Mr. Willett was going to give up the idea that Cissbury was a pre-Roman encampment. He thought the whole circumstance of the hill, and the throwing up of the vallum, was distinctly of an earlier period than Roman.

Mr. **Willett** took it that it was made under the Roman occupation, but by the British.

Mr. **Dennet**: It was a nice piece of engineering—whenever it was done. It was so good that it might have been made not more than fifty years ago.

Mr. **Clayton** said considerable discussion was caused when the society visited Cissbury as to the origin of certain brown marks upon the chalk. He understood that Mr. Willett attributed it to the weather?

The **President** said that, having asked for some of the chalk to be removed that had not previously been disturbed, and having found the same marks as upon the surface, the conclusion he arrived at was that the marks were not caused by the weather. The same marks were, moreover, to be seen in the Hastings sand and other places.

Mr. **Willett**: Then it was a matter of fracture rather than of weather.

Mr. **Scott** wished to say how much pleasure it afforded him to be able to congratulate the society on having amongst them that evening Mr Ernest Willett. He was delighted to welcome him there as his father's son, and also as a rising and painstaking archæologist. It had come to be a kind of fashion to speak of Brighton as a place of pleasure, with nothing else behind; but he did not believe this to be so. During his knowledge of Brighton, the taste for archæology had greatly advanced, and nothing had given him more delight during the last few years than to find that Mr. Ernest Willett was studying that subject with much industry and assiduity. When, on coming to Brighton, he (Mr. Scott) first presided over that department of science, at a *soirée* held at the Pavilion, the gentleman who had previously fulfilled that duty came to him and said that he "did" archæology very differently from the way he had "done" it. Indeed, the gentleman frankly admitted that he had exhibited a lot of things and then did not mind how many fibs he told, so long as he made the people laugh. Mr. Willett, on the present occasion, had not only shown them a lot of things, but he had said a good deal, which, at all events, would make them think. He was delighted with the paper, concerning the general conclusions of which he had no idea until just hearing them from Mr. Willett. He had personally visited the hill, but had not descended the pit, as he was alone and found no workmen near. From what he saw, however, nothing struck him so much as the apparently extraordinary industry of the early people who dug so good a pit so well and with such capital sides and lateral chambers. He was also much astonished at the filling up of the pits. What could one imagine to be the object of the savage in seeking to fill the pits up again? He gathered from Mr. Willett that he thought there had been a gradual filling up of the pits; but he was not quite satisfied upon this point.

Mr. **Willett**: They must have got rid of the excavated chalk in some way.

Mr. G. **Scott** mentioned that a gun flint manufactory was still industriously carried on at Brandon, in Suffolk; the flints being exported to Spain and to South America for the use of the Spaniards, to the Arabs, and to some parts of Russia.

Mr. **Bigge** said the *débris* excavated from Mr Tyndall's pit could be seen from Worthing railway station. What was to be done with it? Was it to be allowed to remain to puzzle people 3,000 years hence?

Mr. **Willett** said it would remain for the present.

Mr. **Payne** suggested whether the names of the farms in the vicinity might not throw some light on the previous condition of the country round about Cissbury? For instance, there were Broadwater and Great Pool farms.

Mr. **Haselwood** said that really the paper which Mr. Ernest Willett had read was so exhaustive that little remained to be said on the subject. If he might throw out a practical suggestion it would be that a Brandon flint napper might be brought to Cissbury to test the quality of the flints there. In the case of the

Brandon pits, there was one layer of flint which could not be used, and a second which was easily worked. He supposed the flints found at Cissbury could be worked.

Mr. **Willett** said a gentleman acquainted with the subject (Mr. Franks) had been into the pits with him, and had given his opinion that the flint at Cissbury was nearly the same, though not quite so good, as that at Brandon.

THE LATE MR. JAMES HOWELL.

The **President** intimated that, since the last meeting, Mr. James Howell, one of the members of the Society, had died. He would suggest whether it was not the pleasure of the members that the hon. secretary should be directed to write to the widow, expressing condolence with her in the loss she had sustained.

Mr. **Dennet**, in seconding the proposition of the President, said his attention had been first drawn to the deceased by reading some interesting newspaper articles which he subsequently learned had been written by him. A delightful interview that followed—notwithstanding that it took place in a sick room—was the beginning of a most agreeable acquaintance; and he warmly endorsed the proposal to send a letter of condolence to the widow.

November 26th.

MICROSCOPICAL MEETING.

This meeting, being a general one, resolved itself into a conversazione.

The **Chairman** (Mr. Haselwood, Vice-President) exhibited a new microscope made by Browning, the Strand, London, constructed on the Jackson model, but possessing the peculiarity of the body and stage being in one, so that no trouble could be experienced in centreing. He (the Chairman) could not say whether this speciality was an advantage or otherwise, as he had but recently obtained it, but its great recommendation was its portability, combined with its excellence.

Mr. W. **Puttick** exhibited Water Spider and Air Tubes of Cockroach.

Mr. R. **Glaisyer**, Young Oysters.

Mr. T. **Glaisyer**, Diatoms, mounted by Möller.

Rev. Mr. **Salt**, Sea Weed and Marine objects from the Brighton Aquarium.

December 10th.

ORDINARY MEETING.—"SPECIMEN EVENING."

THE LATE MR. G. SCOTT.

Mr. **Wonfor**, one of the Hon. Secretaries, said it was with exceedingly painful feelings he alluded to the sad loss which the society and the town had sustained in the death of Mr. George Scott, the Curator of the Free Library and Museum, the honorary librarian, and a vice-president of the society. His heart had been thoroughly with them, and in his official capacity this was particularly manifested by his bringing them into the room in which their meetings were held, and welcoming their presence there a few months ago. As an intimate friend, he had always found him a kind gentleman and a true Christian; and he did not know that anything had ever come upon him with such a severe shock as the intimation of his death. His object in rising at that time was to propose that the condolence of the society at the loss sustained by the removal of Mr. Scott from a sphere of useful action should be conveyed to the relatives of the deceased.

Mr. J. C. **Onions**, the other Hon. Sec., seconded the motion, and, with Mr. J. E. Haselwood, the ex-President, also paid a fitting tribute to the memory of their late member.

The **President** (Mr. Alderman Cox) and Mr. J. Dennant likewise spoke in sympathetic terms of the loss; and Mr. Wonfor read a letter from Mr. C. F. Dennet, conveying an expression of that gentleman's exceeding regret, because of his inability to be present to state how deeply he felt the loss sustained in the demise of Mr. Scott, from whom he had received the first kindness he met with after coming to Brighton.—The proposition was unanimously agreed to.

Mr. WONFOR showed a hard piece of chalk which had been found in an inner wall of the late King's Head, in West street, and which there was every reason to believe had been in the building since its erection, about two hundred years ago. It was bored through by pholades and other creatures, and was rolled as if it had been originally taken from the beach. The object in exhibiting the specimen was two-fold; first, as an illustration of the use of chalk in Sussex for building purposes, and, secondly, to show that chalk, exposed to the action of the sea, acquired a hardness not found in freshly quarried chalk. Many Sussex edifices were built of chalk, faced with flint or stone, such as Lewes Priory and Parham House.

The examination of this piece of chalk led to the remark that gas might be made from chalk; but the President observed that the only gas which could be got from chalk pure and simple by itself was carbonic oxide, and Mr. Wonfor stated that if some hydrocarbon was united with chalk, the streets of Brighton might be lighted by material from the cliffs.

A piece of the pulp of paper extracted from the sugarcane, and a sheet of papier-maché used in the formation of stereotype of the *Times* newspaper of October 16th, 1873, was exhibited by Mr. R. Glaisyer.

In the course of several incidental allusions to aquatic matters, attention was directed to the inestimable value of the Aquarium, to the naturalist especially, and the difficulties which had to be overcome in the preservation of marine life in that institution, and which appeared to be very little understood by the public generally. The Hon. Howe Browne, one of the directors of the Aquarium, who was present, afforded some information under this head, and assured the meeting that the Aquarium Company would be ever willing to provide the society with any specimens of marine life which its members desired to examine and consider, if it were in the power of the directors to do so.

For this assurance the President expressed the gratitude of the society.

JANUARY 14th, 1875.

ORDINARY MEETING.—"ON WINGLESS BIRDS."—

MR. T. W. WONFOR.

The idea ordinarily associated in the mind with the word "bird" was that of a creature possessing the power of flight and, as a matter of consequence, provided with wings. In the north of England "bird" or "brid" was a term used of any flying thing, so that a moth, butterfly, or beetle would be equally included under the term "bird." Now as there were wingless or brevipennate insects, the question might arise, are there wingless birds? in the usual application of the term. We know that the expressions "wingless" and "brevipennate" had been applied to some members of the family *Aves*, yet still, if we inquired into the character of those birds which had been so designated we found that, though we could not in all cases hold that they were flying creatures, yet no one member of the great family of Aves was absolutely deprived of wings. They might be merely rudimentary, as in the case of the *Apterix*, or changed into flappers or paddles as seen in the Penguins, but still they were present and corresponded with the anterior pair of limbs found in all members of the family possessing the power of flight.

THE APTERIX AUSTRALIS.

It was related that a few years since the skin of a bird brought home by someone from New Zealand was given to a taxidermist to set up, and he, taking into consideration the shortness of the wing and absence of tail, and assuming that it was a penguin, stuffed it in a sitting posture, with the head and neck arranged after the manner of the penguins. This bird proved to be the *Apterix Australis*, a native of New Zealand, and, for a bird, exhibiting peculiar features. In addition to an almost want of wing, it presented a strange appearance, the plumage consisting of long flat slender lanceolate feathers, each furnished with a soft shining silken down, for the basal third of their length, and then narrowing rapidly towards the extremity, where they presented the appearance of single shafts, with hair-like webs on each side. The quill portion was very small and short, and overlapped by the down, when the feathers were removed from the skin. Above and below the eye, at the base of the beak, and on the forehead were groups or pencils of long whisker-like hairs. As the kiwi, as the natives called it, was nocturnal in its habits and lived among the fern beds, boring into the ground and seeking shelter in deep excavations, these hairs might serve the same purpose as the whiskers of the cat; and supplement the eye, which, unlike that of the other nocturnal birds, was small. So small was the organ of vision, while the cornea was very convex, and the olfactory system so much larger than in other birds, that Professor Owen remarked, "The nocturnal habits of this bird, combined with the necessity for a highly developed organ of smell, which chiefly compensates for the low condition of the organ of vision, produce the most singular modifications which the skull presents, so that it may be said that those cavities which in other birds are devoted to the lodgment of eyes are in the apterix almost exclusively devoted to the nose." The nostrils externally were very narrow, very small, and set on each side of the tip of the long curved beak, which at this point was somewhat swollen. The internal olfactory apparatus and the pituitory surface, on which the olfactory nerve freely ramified, was complex and extensive. Like all the *Cursores* the legs were very strong and muscular, the tarsi short and stout, the toes, four in number, without intervening webs, the three anterior strong and armed with powerful claws, the hinder one short and terminated by a sort of spur, with which it was said to defend itself very vigorously by striking very rapidly, and with great force. The eggs, for so small a bird, were of great size, and showed the absurdity of judging of the size of an animal from the size of the egg. The eggs weighed on an average 14½ ounces, while the adult bird weighed 60 ounces; the proportion being about 1-4th, while in the common fowl it was 1-48th, and in the case of the ostrich 1-100th; with some animals, such as the alligator and crocodile it was much less.

GIGANTIC BIRDS.

There are, or, if extinct, were, birds of far more gigantic proportions, viz., the dinornis and notornis of New Zealand, and Æpiornis of Madagascar. The *Dinornis giganteus* stood from 14ft. to 16ft. high. Two portions of bone in the Brighton Museum would quite lead, were other evidence wanting, to the belief that the bird was not only of gigantic dimensions, but possessed of immense power of stride. In connection with this bird, it is said that some years ago a traveller returning from New Zealand, brought with him a few inches of bone. This was before the days of the gold discovery; the traveller had heard of the gigantic birds of New Zealand, and also of Professor Owen, to whom the piece of bone was presented. It was big enough in diameter to have been the bone of an ox, but upon examination Professor Owen noticed a peculiar cancellated structure only found in the bones of birds. A bird to possess such a bone must have been considerably larger than an ostrich. He therefore set to work to construct an outline of the bird. The figure, when produced, caused no small amount of disbelief and, as some thought, shewed hasty conclusions on Owen's part. But, causing enquiries to be made in New Zealand, some disjointed bones turned up; these were packed up and sent in a trunk to London; when put together they formed the incomplete skeleton in the Museum of the College of Surgeons. From 14ft. to 16ft. appeared to be the height assigned to the *dinornis giganteus*, the (tibia) legbone measured 2ft. 10in., and the legs to the root of the tail 6ft. An egg found in the volcanic sand by Mr Walter Mantel, was so large that he said his hat would serve as an egg-cup for it. What became of this egg was not known. If, as was asserted by some, the bird was still existing, we might in time obtain a living specimen, or if the capture of it alive was impossible, at least the skin and bones.

THE NOTORNIS MANTELLI.

Another brevipennate bird of the same country, the *Notornis Mantelli*, was captured alive in the year 1849 by some seal hunters. They were ashore in one of the coves of Dusky Bay, the S.W. extremity of Middle Island, when, observing the footprints of a large and strange bird in the snow, they followed the trail and at length came in sight of the bird itself. After a long chase, in which their dogs were very much distressed, they came up with and caught it alive, in a gully behind Resolution Island. They kept it alive on board their schooner for some days, and then killed and skinned it, roasting and eating the flesh, which they pronounced delicious. The skin was procured by Mr W. Mantell, and sent to England. This bird stood about two feet high, the beak was short and strong, wings very short and rounded, plumage feeble, legs and feet more adapted for the land than those of the ordinary rails; plumage rich purple on neck, breast, and abdomen, back and wings decked with green and gold, tail scanty and white beneath; beak and legs, when the bird was alive, bright scarlet.

AN ENORMOUS EGG.

In the Museum was the cast of an egg of enormous size. This was in reality a fac-simile of an egg of the *Æpiornis Maximus* (a supposed extinct bird of Madagascar), in the possession of Mr Dawson Rowley, of Brighton, who had published a pamphlet upon it. Some idea of its comparative size might be gathered when it was stated that it would take 148 fowl's eggs to equal it. The idea respecting this egg was that it was laid by a bird of far larger size than the Dinornis, and, if not still existing in the unexplored parts of Madagascar, that it had not been extinct more than a couple of centuries. Professor Owen, speaking of the eggs of this bird, in a paper read before the Zoological Society in 1852, entitled "Notes on the egg and young of the Apterix, and on the casts of the eggs and certain bones of the Æpiornis," thought it very unscientific to estimate the size of a bird from the size of its egg, and proceeded to show, first that the egg of the *Apterix* might have led to a supposition of its having been laid by a much larger bird; and secondly, that from a comparison of the bones, the *Æpiornis* did not equal in size the *Dinornis Giganteus.*

BREVIPENNATE BIRDS.

Little more than 200 years ago there was on the islands of Mauritius, Bourbon, and Rodiguez sundry brevipennate birds, the *Dodo, Solitaire, &c.*, in great abundance, and, till recently, only a head, a couple of feet or so, and a few bones, with some paintings, were all that remained to tell us of a very interesting group of brevipennate birds. Much interesting matter respecting these would be found in a work in their Library, "The Dodo and its kindred." The living specimen of the Dodo exhibited in London in 1639 passed into the hands of Tradescant, and, when his museum was presented to the University of Oxford by Ashmole, it contained a perfect stuffed dodo. On January 8th, 1755, by an order of the Vice-Chancellor and his co-trustees, it was ordered to be burnt, the head and foot alone escaping destruction. Excavations made in

1865 in the Mauritius by M. de Bissy, for the purpose of utilising the soil of a marsh for manure, led to the discovery of various bones, including those of the deer and tortoise. Mr Clark, who had long had an opinion respecting the possibility of finding bones of the dodo, told M. de Bissy his views. This led to a systematic exploration, and the discovery of many bones of that bird, and now, in the British Museum, might be seen an almost perfect skeleton.

AFRICAN OSTRICHES.

Leaving the region of the comparatively unknown, we came to well-known examples of wingless or brevipennate birds, all belonging to the true *Cursores;* these were the ostriches, the emeu, and the cassowaries. The best known species was the ostrich, *Struthio Camelus,* an inhabitant of the African Continent. This bird, which had been celebrated since the most remote antiquity, and a dish of whose brains was an epicurean dish in Old Rome, measured from six to eight feet in height; its feet consisted of only two toes; the head and neck were nearly naked, the general plumage very lax, the quill feathers of the wings and tail remarkable for the length of their barbs, which, though furnished with barbules, were completely separated from each other, and formed the well-known ostrich feathers of commerce. The ostriches lived together in large flocks, feeding upon grass, grain, wild melons, &c., and, like the gallinaceous birds, which they resembled in their food, had an enormous crop and a strong gizard. In a state of nature it picked up and swallowed small pebbles; but in confinement it had swallowed brickbats, knives, old shoes, scraps of wood, tenpenny nails, bits of iron, and feathers; one went to the length of swallowing in succession the whole of a brood of young ducks—whether impelled by normal hunger, a morbid appetite, or sheer mischief, was an open question. Another tried to swallow its blanket. The voracity of the ostrich formerly gave rise to the belief that it fed on iron. The African ostrich was polygamous and gregarious. The female scratched a hole in the sand, in which she lay ten or twelve eggs in an upright position. The male and female both sat upon the eggs during the night, and this sitting, supplemented by the heat of the sun, hatched those in the middle of the nest, the outer ones, when the centre eggs were hard and the young birds nearly hatched, being quite fit for food; the eggs weighed upon an average 3lbs., and were regarded as great delicacies. Though equal in weight to twenty-four hen's eggs, one was not thought enough for a meal, and in one instance two men finished five eggs in the course of an afternoon. The approved method of cooking was to place the egg upright on the fire, and break a hole in the top, through which a forked stick was forced. This was made to rotate by rubbing with the hands, and so beat up the contents while cooking.

AMERICAN OSTRICHES.

The American Ostriches contained two species. *Rhea Americana* and *R. Darwenii*, and were scarcely more than half the size of the African species, from which they also differed in having the head and neck covered with feathers, and the feet furnished with three toes. The feathers of the wing and tail, though elongated, possessed none of the beauty of the African ostrich, and were only employed in the manufacture of light dusting brooms. They were very abundant in the large plains of America. The food consisted mainly of grasses, roots, and other vegetable substances; but they would occasionally eat animal food, being known to come down to the mud banks of the rivers for the purpose of eating the little fish that had been stranded in the shallows. Darwin, who had frequent opportunities of observing these birds, had given an excellent account of their habits. He says:—"They take the water readily, and swim across broad and rapid rivers, and even from island to island in the bays. They swim slowly, with the greater part of the body immersed, and the neck extended a little forwards. On two occasions I saw some ostriches swimming across the Santa Cruz river, where it was 400 yards wide and the stream rapid." It was polygamous; the male bird prepared the nest, collected the eggs, which were frequently laid by the females at random on the ground, and performed all the duties of incubation. Darwin said four or five females had been known to lay in the same nest, and the male, when sitting, lay so close that he himself nearly rode over one. At this time they were very fierce, and had been known to attack a man on horseback, trying to kick and leap on him.

THE AUSTRALIAN EMEU.

The Emeu of Australia, *Dromaius Novæ Hollandiæ* was nearly as large as the African ostrich, measuring from 5 to 7ft. in height.

It had three toes on each foot, and these were each furnished with nearly equal claws. The head and neck were covered with feathers, the throat being bare, the plumage of the body, closely resembling long hairs, hung down on each side of the body, from a central line or parting. These birds, at one time abundant in Australia, were now becoming extinct, for natives and Europeans were fast thinning them, the former eating the eggs and hunting down the emeus for food, but not allowing boys or women to partake of it, the flesh being reserved for warriors and counsellors. Europeans and settlers ran it with dogs, trained on purpose, for food, sport, and also for a valuable oil, of which as much as six or seven quarts were yielded by a single emeu. This oil was of a light yellow colour, was used as an embrocation for bruises or strains, and not readily congealing or becoming glutinous, was also useful for oiling the locks of fire-arms. They were monogamous, the male performing the office of incubation; the nest was made by scooping out a shallow hole in the ground, in some scrubby spot, and in this depression a variable number of eggs was laid. Dr. Bennett remarked that "there is always an odd number, some nests having been discovered with nine, others with eleven, and others with thirteen." These eggs were nearly as large as those of the ostrich, but of a dark green colour, and the young, when first hatched, were elegantly striped with black and grey. In defending itself it did not kick forward like the ostrich, but sideways and backwards like a cow.

THE CASSOWARY AND THE MOORUK.

The Cassowaries, of which there were at least two—the Cassowary proper, *Casuarius Guleatus*, and the Mooruk, *Casuarius Benettii*—were natives of the Eastern Archipelago. The former, standing 5ft. high, was distinguished by the possession of a peculiar horny crest or helmet upon the head, by the wings being furnished, instead of feathers, with about five cylindrical stalks, destitute of barbs, and by the large size of the claw on the inner toe. The head and neck were naked and wattled, and of a bright red, variegated with blue. The rest of the body, which was very stout, was clothed with long glossy black pendant feathers, more closely resembling hair than those of the emeu. It fed upon herbs, fruit, and seeds, and, like the ostrich, swallowed hard substances. The eggs were of a greenish tint. The eye was fierce and resolute, and the character of the bird was tetchy, and it was apt to take offence without any apparent provocation. Scarlet cloth excited its ire, and it had a great antipathy to ragged and dirty persons. The height of the mooruk was 3ft. to the top of the back, and 5ft. when standing erect. The colour was rufous, mixed with black on the back and hinder portions of the body, and raven black about the neck and breast; the loose wavy skin of the neck was coloured with irridiscent tints of bluish purple, pink, and an occassional shade of green; the feet and legs were large and strong, of a pale ash colour, and exhibited a peculiarity in the extreme length of the claw of the inner toe of each foot, it being nearly three times the length of the claws of the other toes. Instead of the helmet-like protuberance of the cassowary, it had a horny plate resembling mother-of-pearl darkened with black lead.

THE PENGUINS.

Another set of birds, if not wingless, should also be mentioned, these were the Penguins, in which birds the wings were reduced to a rudimentary character, were destitute of quills, and were covered with a scaly skin forming flat fin-like paddles, the scales being rudimentary feathers. In the water, which appeared their natural element, they used them in swimming and diving. On shore they used the paddles as anterior legs. From the backward position of their feet the Penguins could only stand in a very upright attitude, in which position they might be seen in countless numbers arranged in as compact a manner and in as regular ranks as a regiment of soldiers, and classed with the greatest order, the moulting birds in one place, the young ones in another, the sitting hens by themselves; the clean birds in another place, &c. So strictly did birds in a similar condition congregate that should a bird in a moulting state intrude amongst those which were clean, it was immediately ejected from among them.

THE PLUMAGE OF WINGLESS BIRDS.

Apart from what might be called the absence of wings or rather the presence of merely rudimentary wings, wingless birds, leaving possibly the penguin and dodo out of the category, were distinguished from other birds by certain marked qualities. In all of them the plumage differed from that of those possessing the power of flight, the barbs of the feathers being always separate, and the whole covering approaching very nearly the character of the hair of animals. The bones, too, were almost destitute of the air cells which gave so much lightness to the skeletons of ordinary birds, and assimilated more closely to mammalian bone. From the mere rudimentary character of the wings there was an almost absence of pectoral muscles, and the sternum was reduced to a simple convex shield without any trace of the keel which in other birds gave attachment to the powerful pectoral muscles. To compensate for this deficiency, the great size and muscularity of the legs rendered the pace of these birds in running very swift. The pelvis was of a large size, and the two sides of the arch united at the pubis; this was not the case in other birds. The anterior toes were strong, either two or three in number, and terminated by strong nails. The hinder toe, except in the genus *Apterix*, where it was rudimentary, was entirely wanting. So strong were the legs and muscles in the ostrich, that it would knock over a hyena with a stroke, or rip up a dog with its claw. At bay it had knocked down, and trampled upon the hunter who had approached it incautiously.

THE ABODE OF BREVIPENNATE BIRDS

It must have been noticed that all the brevipennate *cursores* were confined either to islands or two Southern continents, and were of great size. How could this be accounted for; and was there anything to explain the fact? First, as regarded the islands, it seemed geologically evident that they, comparatively recently in geological time, formed a part of the great Asio-African Continent and that, when the separation took place, the ancestors of all these gigantic and brevipennate birds were shut up in the islands together with smaller birds, with the same lax plumage and feeble powers of flight, those only of large size and swiftness of foot escaping from their natural enemies shut up with them. That a ravenous and active enemy in a small island would soon cause the extinction of a small and feeble brevipennate bird was seen by what happened in the Samoan group of islands. There was a Dodolet, the *didunculus strigirostris*, a pet with the natives, and a connecting link between the true pigeons and the Dodo. European vessels touching at these islands left behind them rats, which increased and multiplied until, like Dick Whittington's so-called cat of fable, but not the ship of reality, they introduced the domestic cat; it not only kept down the rats, but destroyed the *didunculus*, which became, as was believed, extinct, until a few months ago living specimens were found and wrongly described in the journals as the true Dodo.

THE SILK FOWLS.

Absence of wings and hairiness of plumage was seen under domestication in what were known as Silk Fowls. The origin was said to have been from an ordinary pair of Chinese fowls. A single bird thus clothed was hatched from an egg laid by the hen, the cause, though determining the variation, being unknown. By a careful and long-continued selection of the offspring of this fowl showing the most complete tendency to develope the peculiarity of feathers, the breed of silky cochins was at length established. It was well-known to pigeon fanciers that similar laxity of plumage existed among them. Given therefore a tendency to laxity of plumage, and but moderate powers of flight, natural selection would explain on Darwin's hypothesis, how, as the powers of flight diminished, only the larger and more powerful would survive, while the smaller and feebler would easily fall a prey to their natural enemies, while the use of the legs and disuse of the wings would also in time produce the swift and strong *cursores* like the ostrich, emeu, &c.

A vote of thanks to Mr Wonfor for his paper was proposed by the President, Mr Alderman Cox. He thought it was very fortunate for them that they could have such a stop-gap as they had. Being personally perfectly ignorant of the subject treated, the meeting, he said, would understand what a great temptation it was for him to say much about it. There was a tendency in human nature to say most about that of which they knew least, but he would refrain from indulging in this natural propensity by merely proposing a vote of thanks in return for the instructive paper read.—This proposition was heartily responded to.—A short conversation was then engaged in, the Chairman, Mr Moore, Mr Hennah, Mr Onions, Mr Dowsett, Mr C. W. Wallis, and one or two others taking an active part in it.

To the Chairman the question suggested itself, whether the rudimentary organs of brevipennate birds were in progress of development into something else, or had been wings and became reduced through disuse, or had been always stunted.

Darwin's belief in the second alternative was alluded to by Mr Wonfor; but in opposition to this, Mr Moore gave the result of his practical experience in New Zealand. There he had found that brevipennate birds existed principally on soil roots, and consequently had no use for wings.

Mr **Dowsett** would not allow that there were so great modifications in nature as Darwin suggested, although he admitted that there were great modifications, the result of human agency. Why were the birds mentioned not specially created in a form adapted to the spheres they occupied?

Another difficulty in believing Darwin's theory was referred to by the Chairman; this was the density of the bone in the brevipennate birds, in contrast with the animals themselves.

To meet Darwin half-way, Mr Wonfor suggested that, instead of admitting that all forms of birds had been developed from a few types, some acquiring greater powers of flight, and some ceasing to fly altogether, they might concede that brevipennate birds had all developed from one type, of which, perhaps, the ostrich or dinornis was the original.

January 28th.

MICROSCOPICAL MEETING.—"ROCK SECTIONS."

The subject was to have been introduced by another gentleman, but was in his absence introduced by Mr. T. W. Wonfor, the hon. sec., who, since the last meeting of the society, had been elected Curator of the Free Library, Museum, and Picture Gallery

After referring to the barrenness of scientific literature upon the subject, Mr Wonfor proceeded to give a brief but comprehensive sketch of the rock systems, constituting the crust of the earth, and explained the characteristics of the three groups, the igneous, the aqueous, and the organic. Dealing with the latter first, he showed how at the present time rocks were being built up in the beds of the Atlantic, the Pacific, and elsewhere, the component parts of which were similar to our chalk cliffs, mountain limestone, or coal formations. The first two were made up of minute organisms, and, taking into consideration the time necessary to form these rocks, the age of the earth must be pushed much further back than where it had been placed by many geologists.

The aqueous rocks bore distinct evidences of having been formed under water; and in the igneous rocks, more particularly in granites, minerals were found; while many rocks supposed to be igneous contained water, glass, stone, and gas cavities.

One stumbling block to independent Microscopical research amongst rocks was that so much aid was required from the lapidary's wheel, and the preparing of specimens for microscopic inspection thus became an expensive amusement.

The meeting then became a conversazione, when about six dozen sections, supplied by Mr. Wonfor, were exhibited, by different gentlemen present amongst the principal being granite, porphyry, felspar, jasper, obsidian, basalt, pitchstone, quartz, agate, limestone, oolites, chalk, coal, and lignite.

FEBRUARY 14th.

ORDINARY MEETING.—MR. T. DAVIDSON, F.R.S., F.G.S., ON "WHAT IS A BRACHIOPOD?"

Having been requested by some members of the Brighton Natural History Society to tell them what a Brachiopod is, he would endeavour to do so in as brief a manner as so extensive a subject would admit. All were aware that it was very often much easier to put a question than to obtain an entirely satisfactory answer, and he was consequently sorry to have to begin his few observations on a very extensive group of organisms by stating that zoologists and comparative anatomists had not yet entirely agreed as to the exact position it should occupy among the invertebrate animals. The first species belonging to the class were imperfectly and quaintly described and figured by Prince Fabio Columna, as far back as 1606, and for many years were supposed to be referable to the genus

Anomia of the *Lamelli branchiata*; but, as was judiciously observed by Edward Forbes, "a close examination shows that there is no relationship between them, but only a resemblance through formal analogy." It was during the present century that the class itself had been worked out and understood, and this had been achieved only after the most lengthened and persevering researches.

NAME.

The name Brachiopod (an arm, a foot) was proposed for the class by Cuvier in 1805, and by Dumeril in 1809, and had since been very generally adopted. Professor King, perhaps rightly, objected to the term on the grounds that it was a misnomer, for the two variously curved and cirrated brachial appendages, improperly designated as arms or feet, were subsequently found not to subserve the function of locomotive organs. Blainville, in 1824, proposed as a substitute for Cuvier's name that of Palliobranchiata (a mantle, gills), on account of the respiratory system being combined with the mantle on which the vascular ramifications are distributed.

SHELL.

Before alluding to the position the Brachiopod should occupy amongst the invertebrata, he might, at once, observe that the animal was protected by a shell composed of two distinct valves; and that these valves were always, except in cases of malformation, equal sided, but not equivalved. The shell was likewise most varied and beautiful in its endless shapes and variations; in some species it was semi-transparent, and glassy, in others massive; generally the shell was from a quarter of an inch to about four inches in size, but in certain species was nearly a foot in breadth by something less in length, as was the case with *Productus Giganteus*. The valves were often very unequal in their respective thickness, as might be seen in *Productus Llangollensis*, *Davidsonia Verneuilii*, &c., and while the space allotted to the animal was very great in a number of species it was extremely small in many others. The outer surface of many of the species presented likewise the most exquisite sculpture, heightened by brilliant shades, stripes, or spots of green, red, yellow, and bluish black. The valves had been distinguished by various names, but those of dorsal and ventral were in more general use. The ventral one was usually the larger; in many genera, as *Terebratula* and *Rhynchonella*, had a prominent beak with a circular or otherwise shaped perforation or foramen at, or near, its extremity, partly completed by one or two plates termed a deltidium; through the foramen passed a bundle of muscular fibres termed a peduncle, and by which the animal was, in many species, attached to sub-marine objects during at least a portion of its existence. It was, however, certain, from the admirable researches of Professor Morse, that the embroyo of some, if not of every species, swan most actively in every direction and turned abruptly about; but that, in the fourth stage of its development, it became attached, the peduncle widening at its end into a sucking disk. Other species showed no indication of ever having been attached, while some, that had been fixed by means of a peduncle during a part of their existence became attached at a more advanced stage of life, the opening for the peduncle becoming gradually cicatrized. Lastly, certain forms appeared to have adhered to submarine objects by a larger or smaller portion of the surface of their ventral valve, or by spines *(Strophalosia)* during their entire life. In external shape the valves were essentially symmetrical, which was not the case with the Lamellibranchiata, so much so, that certain Brachiopod shells received the name of Lampides from some early naturalists, but while such might bear an obscure kind of resemblance to an antique Etruscan lamp, by far the larger number in no way resembled one. The valves were also either articulated by means of two curved teeth developed from the margin of the larger valve and fitting into sockets in the corresponding part of the smaller one, or they were unarticulated and kept in place or in juxtaposition by the means of muscles especially provided for that purpose.

SHELL STRUCTURE.

The structure of the shell had been shown by Dr Carpenter, Professor King, and others to be generally distinct from that of the Lamellibranchiata or Gasteropoda. In some families, according to Professor King, it consisted of three divisions, the innermost and middle divisions, which constitute the entire thickness of the valve, were calcareous, with a prismatic or fibrous structure; while the outer division consisted of a very thin membrane. The innermost and intermediate divisions in some families were traversed by minute tubular canals, which passed from one surface to the other, for the most part in a vertical direction, and at tolerably regular intervals; but, just before terminating near the outer surface of the epidermis, their tubular orifices suddenly became dilated, the lower half of the canal was often considerably smaller in diameter than the upper half. The canals were occupied by coecal processes proceeding from the mantle or fleshy covering of the animal. Their functional nature was, according to Dr. Carpenter, branchial in their office, and subservient to respiration; but, as observed by Professor King, the outer epidermis, which covered their expanded termination, would seemingly prevent any communication between the surrounding sea water and the mantle, so that it might be questioned whether they were at all connected with the respiratory function. In certain genera, such as *Lingula*, there were no canals, the shell being found to consist of flattened prisms of considerable length, and which lay parallel to one another with great regularity, and at a very acute angle. The shell substance was also either almost entirely composed of a horny or of a calcareous substance.

INTERIOR OF VALVES.

Having described the exterior of the shell, he must add a few words with respect to the interior. On the inner surface of both valves several well defined muscular impressions were observable; these varied considerably in position and shape in different species. They formed either indentations of greater or lesser size and depth, or occurred as variously shaped projections. In the *Trimerellidæ* some of the muscles were attached to a massive or vaulted platform situated in the medio—longitudinal region of the posterior half or umbonal portion of both valves. In addition to these there existed in the interior of the dorsal valve, in some genera a variously modified thin calcified ribbon-shaped lamina or skeleton for the support mainly of the brachial or labial appendages, and so varied and constant were these in shape to certain species that this laminal apophysis had served as one of the chief characters in the creation of both recent and extinct genera. In certain forms the lamina was more or less developed, and so bent as to assume the shape of a loop. The loop was in some genera attached only to the hinge-plate, as in *Terebratula*, *Waldheimia*, &c., in others likewise so to a central longitudinal plate or septum. In certain families the apophysis presented the form of two spiral processes, which nearly filled the interior of the shell, the ends of the spires being either directed outwardly towards the cardinal angles *(Spirifer)* or placed horizontally with their apices directed inwards and towards the centre of the concave surface of the same valve, which they almost filled, the inner side of the spires were pressed together and flattened with thin terminations close to each other, near the centre of the bottom of the shell *(Atrypa)*. In the Rhynchonellidæ again it assumed the shape of two short slender curved laminæ, while in many genera, and even families, Productidœ, &c., there existed no calcified support for the branchial appendages.

SOFT PARTS OF ANIMAL.

He must very briefly allude to the soft parts of the animal, but it would require much more time than could be bestowed to his short lecture, to do anything like justice to so difficult and complicated a subject. He was, however, truly happy in being able to inform the society that this important enquiry had been most ably and successfully elaborated during the last twenty years, and by some of the most distinguisned anatomists of the period. To such men as Owen, Huxley, Hancock, Gratiolet, Vogt, Morse, and others, we were indebted for an extensive series of the most elaborate and accurate dissections and observations, which had defined to a very considerable extent, what were the true characters of the Brachiopod, while some important researches elaborated by Steenstrup, Lacage-Duthiers, Morse, Dr. Fritz Müller, Oscar Schmidt, McCrade, Kowalevsky, and others, had thrown much additional light upon the embiyology, or early stages, of the groups. Some differences of opinion, it was true, had been, and were still, entertained with respect to the exact function to be attributed to certain parts of the animal; but on all essential questions there was a pretty general agreement. Before describing the soft parts of the animal, it might be as well to mention that Brachiopoda had been divided into two great groups by Bronn, which he termed *Apygia* and *Pleuropygia*, considering them to be inadmissible on certain grounds. Professor King substituted the name *Clistenterata* for the first group, on account of its including animals destitute of an anal aperture; and the term *Tretenterata* for the second, as it embraced animals provided with this organ. The former division contained species which had their valves articulated as *Terebratula, Spirifer, Rhynchonella*, the latter comprised species with non-articulated valves as *Lingula discina*, &c. Some very important modifications in the animal were connected with these two divisions, especially in what related to the muscular system. According to Morse, the Brachiopod were reproduced by eggs, generally kidney-shaped and irregular, which were discharged from the anterior margin of the shell, and dropped just beyond the pallial membrane, hanging in clusters from the setœ. Some uncertainty had prevailed as to whether there was a male and female individual; Lacage-Duthiers and Morse stated that the sexes were separate and described them as such in *Thecidium* and *Terebratulina*, and the French zoologist went so far as to suggest that a difference was even observable in the shell. Professor Morse described the embryo of *Terebratulina* with great minuteness during its six stages of development. It was divided into two, three, or four lobes clothed with vibratile cilia; and before becoming attached, swam or whirled head foremost by means of vibratile cilia which covered the body.

MANTLE.

Both valves were lined by the delicate membrane, termed the "pallium," or mantle; it secreted the shell, and was generally fringed with horny bristles, or setœ. The mantle was composed of an outer and inner layer, between which were situated blood channels or lacunes. These arterial trunks and veins constitute the vascular system. On certain parts of the surface of the mantle occurred a vast number of microscopic, flattened, calcareous, denticulated plates, or spiculæ, destined, no doubt, to stiffen the portions that contained them. The digestive organs, viscera, as well as the muscles, took up only a small place in the contiguity of the beak, and were separated from the general cavity by a strong membrane, in the centre of which the mouth is located. The nervous system consisted of a principal ganglion, of no great size.

BRACHIAL APPENDAGES.

He must next briefly describe those beautiful and singular organs, eminently characteristic of the Brachiopoda, termed arms, or more correctly *labial*, on account of each member being a prolongation of the lateral portion of the lips or margin of the mouth; the lamellibranchs, or conchifera, had analagous appendages, but very much less developed. They assumed different shapes in different genera, and were supported, or otherwise, by the more or less complicated calcified skeleton, already described. These two long, bent, or spirally convoluted organs, occupied the larger portion of the cavity of the shell, and were mainly composed of a membranous tube, fringed on one side with long flexible cirri. The brachial appendages occupied, therefore, nearly the entire pallial cavity, but were not capable of being protruded in those families and genera in which they were folded upon themselves, or supported by a calcareous skeleton. In Rhynchonella, where the elongated spiral arms were but slightly supported at their origin by two short projecting calcareous processes, they could, at the will of the animal, be unrolled, and protruded to some distance beyond the margins of the shell, and, when forcibly stretched out, were said to be more than four times the length of the shell, and to support some 3,000 cirri. It must, however, remain for ever uncertain whether, in those extinct genera, such as Spirifer and Atrypa, where the spirally coiled fleshy arms were supported throughout their entire length by a calcified skeleton, the animal could protude its brachial appendages beyond the margin of the valves. In some families, *Rhynchonellidæ*, *Productidæ*, the arms are spiral and separate, in others, *Lingulidæ*, only at their extremities, and it was almost certain that these beautiful organs by means of their cirri and the cilia, with which they were doubtless furnished, were not only instrumental in carrying floating nutrimental particles or minute organisms to the mouth, but were subservient to the functions of respiration.

MOUTH: HEARTS.

The mouth conducted by a narrow œsophagus to a simple stomach, which was surrounded by a large granulated liver. Owen's "hearts" had been found to be oviducts, while the true heart would consist of a pyriform vesicle, appended to the dorsal surface of the stomach.

MUSCLES.

He must next speak of the muscular system, and as the number and position of these muscles differed materially in the two great divisions into which the Brachiopoda had been separated, and to some extent also in the different genera of which each division was composed, it might be desirable to treat the subject under two different heads in the *Clistenterata*, of which the genus *Terebratula* might be taken as an example, five or six pairs of muscles were stated by Hancock and others to be connected with the opening and closing of the valves, or with their attachment to, or movements upon the peduncle. First of all, the adductors, or occlusors, consisted of two muscles, which, bifurcating near the centre of the shell cavity, produced a large quadruple impression on the internal surface of the small valve, and a single divided one towards the centre of the large or ventral valve. The function of this pair of muscles was the closing of the valves. Dr. Gratiolet who had likewise described with great minuteness, the muscles of the Brachiopoda, informed us that those which close and open the valves were the only ones known to Pallas, but that he defined their positions and functions clearly. The same was done by Blainville and Quenstedt. The next two pairs of muscles had been termed divaricators, or cardinal muscles, and had for function the opening of the valves. The divaricators proper were stated by Hancock to arise from the ventral valve, one on each side, a little in advance of and close to the occlusors, and after rapidly diminishing in size became attached to the cardinal process, a space or prominence between the sockets in the dorsal valve. The accessory divaricators were, according to the same authority, a pair of small muscles which had their ends attached to the ventral valve, one on each side of the median line, a little behind the united basis of the occlusors, and again to the extreme point of the cardinal process. Two pairs of muscles appeared to be connected with the peduncle and its limited movements had been minutely described by Hancock as having one of their extremities attached to this organ. The dorsal adjustors were attached to the ventral surface of the peduncle and again inserted into the hinge plate in the smaller valve. The ventral adjustors were considered to pass from the inner extremity of the peduncle and to become attached by one pair of their extremities to the ventral valve, one on each side of, and a little behind, the expanded base of the divaricators. The function of these muscles was not only that of erecting the shell, but also to attach the peduncle to the shell, and thus effect the steadying of it upon the peduncle. Such was the general arrangement of the shell muscles in the division comprising the articulated Brachiopoda, allowance being made for certain unimportant modifications observable in the shells composing the different families and genera thereof. In the *Tretenterata*, of which Lingula might be quoted as an example, the myology was much more complicated, and anatomists had differed considerably in their respective views concerning the function of some of the muscles. It would not, however, be possible to discuss the opinions of Hancock, Vogt, Gratiolet, and others, but he would refer to and adopt those recently advocated by Professor King, as they seemed to carry with them a greater degree of plausibility. Of shell or valvular muscles, Professor King, made out five pairs and an odd one. Three pairs were laterals having their members limited to the sides of the shell; one pair were transmedians, each member passing across the middle to reverse side of the shell, one pair had its members confined to the central region; while the odd muscle occupied the umbonal cavity, and he assumed that the central and umbonal muscles effected the direct opening and closing of the shell; the laterals enabled the valves to move forward and backward on each other, while the transmedians allowed the similar extremities (the rostral) of the valves to turn from each other to the right or the left on an axis subcentrically situated, that was in the medio transversed region of the dorsal valve. It was long a matter in discussion whether the animal could displace its valves sideways when about to open its shell, but this matter had been set at rest by Professors Semper and Morse, who actually observed the animal perform the operation; they mention that it was never done suddenly or by jerks, as the valves were at first always pushed to one side several times and back again on each other, at the same time opening gradually in the transverse direction, till they rested opposite to each other and widely apart. Those who had not seen the animal in life, or who did not believe in the possibility of the valves crossing each other with a slight obliquity, would not consent to appropriating any of its muscles to that purpose, and consequently attributed to all the lateral muscles the simple function of keeping the valves in an opposite position, or holding them adjusted. They had not only the observations of Semper and Morse, but the anatomical investigations of King, to confirm the sliding action or divarication of the valve of *Lingula*. In the *clistenterata*, where no such sliding action of the valves was necessary or possible, no muscles for such an object were required; consequently none took rise from the lateral portions of the valves as in *Lingula*, but, in an extinct group, the Trimerellidæ, which seemed to be somewhat intermediate in character between the Tretenterata and Clistenterata, certain scars which had been found, appeared to have been produced by rudimentary lateral muscles, but it was doubtful (considering the shells are furnished with teeth, though but rudely developed) that such muscles enabled the valves, as in *Lingula*, to move forward and backward upon each other. There were muscles connected with other portions of the animal, such as the parietal muscles so strongly defined in the Tretenterata, and distinctive peculiarities of the Peduncle, &c., but which the limited time at his disposal would not allow him to describe.

AFFINITIES OF THE BRACHIOPODA.

It was, however, time that he should say a few words in connection with the systematic position of the Brachiopoda. As they were aware, the invertebrata had been grouped into five sub-kingdoms, namely, the *Protozoa*, *Cœlenterata*, *Annuloida*, *Annulosa*, and *Mollusca*; and that for many years the Brachiopods had been considered to constitute a separate class among the mollusca, a view still maintained by several distinguished naturalists. Subsequently, the class was removed from the Mollusca proper, and placed along with the Polyzoa and Tunicata into a division to which the name Molluscoidea was given. Again, within the last few years, Professors Kowalevsky and Morse, in several very able memoirs, had strongly urged that the Brachiopods should be considered to constitute a separate group among the Annelids, and it must be admitted that the American and Russian zoologists have clearly shown that several portions of the animal of the Brachiopod and Amphetrite presented important characters in common; but, at the same time, as was observed to him by Professor Verrill, almost any invertebrate group may be *anneledelized* by overrating certain points of their affinities; nor could one cast aside many true molluscous characters presented by the Brachiopod, and, as was justly observed by Stoliczka, there cannot be, he thought, much doubt as to the true molluscous character of the Brachiopod and their proper classification between the *Anomiidæ* of the *Pélecypoda*, and *Saccopoda*, and the arm bearing section of the *Ciliopoda*. The subject in connection with the systematic position of the Brachiopoda must, therefore, be left, for the present, as an open question, although he was still in favour of the opinion that the class should be considered to constitute a distinct group among the Molluscoidea.

RANGES OF DEPTH.

All Brachiopoda were inhabitants of the sea, and had been met with at depths ranging from less than a foot to that of 2,600 fathoms, between Kerpules Island and Melbourne. (Her Majesty's Challenger expedition). Some Lingulæ lived partly buried in mud; while Professor Morse described a species of the genus which he found in vast numbers "in a sand shoal at low water mark buried just below the surface of the sand. The peduncle, six times the length of the shell, was partly encased in a *sand tube* differing in no respect from the sand tubes of neighbouring annelids. He observed (likewise) that *Lingula pyramidala* had the power of moving over the sand by the sliding motion of the two valves, using at the same time the fringes of setæ, which swung promptly back and forth like a galley of oars, leaving a peculiar track in the sand. In the motion of the setæ he noticed the impulse commencing from behind and running forward. The larger number of species lived, however, at depths from five to three or four hundred fathoms, some apparently in the free condition, others attached by their peduncle to various marine objects, and very often to coral reefs. Discina had been found attached to stone at low water, and been dredged from depths ranging from five to nearly 2,000 fathoms (*Discina atlantica*). Mr. Jeffreys did not believe that the habitat of any invertebrate animal was affected by bathymetrical conditions. Jukes got any number of *Waldheimia flavescens* while boating in Australia among the reefs, they were merely washed by the tide, and he gathered them with his hand like limpets on the shore. Certain minute forms were found by Mr Jeffreys fixed to seaweeds, while others adhered by a larger or smaller portion of one of their valves to submarine rocks, stones, corals, &c.

CLASSIFICATION.

It would not be possible on so brief a paper to enter at any length on the subject relating to the classification of the Brachiopoda. This important matter would be found fully discussed up to the year 1853 in the general introduction to his great work on "British Fossil Brachiopoda." He then published his own views, and which were subsequently very generally adopted both by British and foreign palæontologists, but he did not omit to impress upon his readers that we were not then, nor were we even yet, quite in a condition to prepare a really complete, permanent, or wholly satisfactory classification of the numerous species composing the class. In 1853, he divided the Brachiopoda into eight families, comprising twenty-four genera and twenty-two sub-genera, but during the years that had elapsed since 1853 up to the present time some seventy-two more genera or sub-genera had been proposed, and of which he published a list in the *Sussex Daily News* newspaper for the 20th of August, 1872. Much consideration on his part had been devoted to the subject, but he felt that in order to place the known genera and species into their respective families, or into new ones that would have to be created, much more information would have to be acquired. The subject was immense, when one had to grapple with between five and six thousand described species, varieties, or synonyms. J. Bigsby gave a list of upwards of three thousand species alone from the palœozoic rocks, and it must likewise be borne in mind that many of the extinct genera had as yet been but imperfectly elaborated. The material in hand was, however, so great that, with time, palæontologists would be able to lay before the public a complete history of a class, which, as would be shortly shown, had played an important part in the great life-system of our globe, from its dawn to the present time. It would be necessary though, to admit the two great divisions *Tretenterata* and *Clistenterata* into any scheme of classification, although it was impossible to say whether or not all the extinct genera were provided or otherwise with an anal aperture. The *Tretenterata* comprised the families *Lingulidœ*, *Discinidœ*, *Craniadœ*, and (?) *Trimerellidœ*. Each of these families was composed of several genera. The *Clistenterata* would include the families *Terebratulidœ*, *Rhyconchonellidœ*, *Spiriferidœ*, *Strophomenidœ* and *Productidœ*. By far the larger number of described genera and species would have to be located in this great division of the Brachiopoda.

DISTRIBUTION IN TIME.

Assuming that they were all acquainted with the geological divisions into which the crust of this earth had been grouped, he might at once observe that, as was justly remarked by Barrande, the Trilobites and Brachiopoda occupied the most important place in the primordial fauna of our globe, and if we excluded the problematical *Eozoon canadense* from the animal creation, as some naturalists had done, we should find the Brachiopoda making their first appearance in the oldest known fossiliferous deposits, for Mr. Hicks had obtained undoubted examples of *Lingula* or *Lingulella*, (*L. primæva*) from the very base of the whole Cambrian series of St. Davids. They were less numerous during the Permian and Triassic periods, while they again became abundant, although comparatively much less numerous, during the Jurassic and Cretaceous times. In the Tertiary period they had materially decreased in number, and were represented at the present time by about one hundred species. But what wonderful changes had been operating during the incalculable number of ages in which the creation (?) and extinction of a large number of genera, and thousands of species, had taken place, some few only of the first created genera, such as *Lingula*, *Discina*, and *Crania*, have fought their way and struggled for existence through the entire sequence of geological times. Many were destined to a comparatively ephemeral existence, while others had a greater or lesser prolongation of reproduction. These remarks led him to give some extracts from a letter which he received from Darwin as far back as the 26th of April, 1861. In that letter, that eminent and admirable observer writes, "I do not know whether you have read my 'Origin of Species.' In that book I have made the remark, which I apprehend will be universally admitted, that, *as a whole*, the fauna of any formation is intermediate in character between that of the formation above and below. But several really good judges have remarked to me how desirable it would be that this should be exemplified and worked out in some detail, and with some single group of beings. Now, every one will admit that no one in the world could do this better than you with Brachiopods. The result might turn out very unfavourable to the views which I hold; if so, so much the better for those who are opposed to me. But I am inclined to suspect that, on the whole, it would be favourable to the notion of descent with modification. I can hardly doubt that many curious points would occur to anyone thoroughly instructed in the subject, who could consider a group of beings under this point of view of descent with modification. All those forms which have come down from an ancient period very slightly modified ought, I think, to be omitted; and those forms alone considered which have undergone considerable change at each successive epoch. My fear is whether the Brachiopods have changed enough. The absolute amount of difference of the forms in such groups at the opposite extremes of times ought to be considered; and how far the early forms are intermediate in character between those which appeared much later in time. The antiquity of a group is not really diminished, as some seem to think, because it has transmitted to the present day closely allied forms. Another point is, how far the succession of each genus is unbroken from the first time it appeared to its extinction, with due allowance made for formations poor in fossils. I cannot but think that an important essay (far more important than a hundred literary reviews), might be written by one like yourself, and without very great labour," &c. In several subsequently written letters, Darwin reiterated his suggestion. He could assure them that he had not neglected a request coming from so eminent a quarter; but he was bound to state that he had found the subject beset with so many apparently inexplicable difficulties, that year after year had passed away without his being able to trace the descent with modification among the Brachiopoda which the Darwinian Doctrine required. The imperfection (one due, he believed to our slight acquaintance with the subject) in the geological record could not in many cases be doubted, but we had no right to make capital out of unknown data, we must therefore deal with facts as we found them, and see how far they would bear upon the subject under examination. It was quite true that strata at great distances could not be positively asserted to be, strictly speaking, absolutely contemporaneous, although they might contain the same animal remains. It was very probable that some species might have emigrated from the sea bottom on which they originally lived to some more favourable locality, and become to some extent modified. No one could seriously doubt that life had continued to be represented under one form or another ever since it was first brought into existence. He consequently could not agree with Deshayes and others who believed in a total extinction of the animal creation at certain specified periods. Notwithstanding the theoretical doctrine that had been promulgated with respect to the origin of species, we were still, and would probably for ever remain, in the dark, or within the region of suppositions with respect to so important a question. In his admirable address to the Belfast meeting of the British Association, Tyndall observes, "If you ask me whether there exists the least evidence to prove that any one form of life can be developed out of matter, without demonstratable antecedent life, my reply is that evidence, considered perfectly conclusive by many, has been adduced, ... but there is in the true man of science a wish stronger than the wish to have his beliefs upheld—namely, the wish to have them true;" and he adds further on, "that these observers will frankly admit their inability to point to any satisfactory experimental proof that life can be developed save from demonstratable antecedent life," and that the whole process of evolution is the manifestation of a power absolutely inscrutable to the intellect of man.

Darwin's tempting and beautiful theory of descent with modification bore a charm that appeared to be almost irresistible, and he would be the last person to assert that it might not represent the actual mode of specific development. It was a far more exalted conception than the idea of constant independent creations, but we were stopped by a number of questions that seemed to plunge the conception into a maze of inexplicable, nay mysterious, difficulties; nor had Darwin, as far as he was aware, said how he supposed the first primordial form to have been introduced. The theory was at best, as far as we could at present perceive, with our imperfect state of knowledge, but half the truth, being well enough in many cases between species and species; for it was evident that many so-termed species might be nothing more than modifications produced by descent. It applied likewise to accidental variations, as between closely allied genera, yet there was much more than this with respect to which the Theory seemed insufficient. The strange geological persistency of certain types such as of *Lingula*, *Discina*, *Nautilus*, &c., seemed also to bar the, at present, thorough acceptance of such a theory of general descent with modification.

What did the Brachiopoda tell us upon this question. Taking the present state of our knowledge as a guide, but admitting at the same time that any day our conclusions and inductions might require to be modified from fresh discoveries, let them ascertain whether they revealed anything to support the Darwinian ideas. They found that by far the larger number of genera made their first appearance during the Palæozoic period, and, since then, had been decreasing in number to the present period. They might leave out of the question the species, for they varied so little that it was often very difficult to trace really good distinctive characters between them, it was different with genera as they were, or should be, founded on much greater and permanent distinctions. Thus, for example, the family of *Spiriferidæ* included genera characterised by calcified spiral lamina for the support of the brachial appendages, and however varied they might be they always retained the distinctive characters of the group from their first appearance to their extinction. The Brachiopodist laboured under the difficulties of not being able to determine what are the simplest, or which are the highest, families into which either of the two groups of his favourite class was divided, so far, then, he was unable to point out any evidence favouring progressive development in it, But, confining himself to species he had often before him great varietal changes, so much so, as to make it difficult for him to define the species; and it led him to the belief that such groups were not of independent origin, as was universally thought before Darwin published his great work on the origin of species. But in this respect the Brachiopoda revealed nothing more than other groups of the organic kingdom. All the *Productidæ* had their permanent and constant characters, and so on. It would appear that the earliest forms among the Brachiopoda are referable to the division *Tretenterata*, which included the genera *lingulella, lingula, discina,* and *obolella*. Of these, *lingula* and *discina* only had lived on with but slight modifications in external shape, during the entire sequence of geological time, and they were still represented by several species, but in rocks, somewhat later in age, the Menevian group, or lower lingula flags, there occurs a species of *orthis*, the first representative, as far as they were aware, of the division *Clistenterata*, but there was not the slightest evidence that *orthis* was ever derived from any of the four genera of *Tretenterata* above named. Since that period both divisions continued to be represented, without ever showing a tendency to pass one into the other. Now, although certain genera, such as *Terebratala, Spirifer, Rynchonella, Crania, Discina,* and *Lingula,* had enjoyed a very considerable geological existence, and had varied very little since their first appearance, and might be looked upon as among the earliest Brachiopoda, there were genera such as *Stringocephalus, Uncites, Porambonites, Koninchina,* &c., which made their appearance very suddenly and without any warning, and disappeared in a similarly abrupt manner, having enjoyed a comparatively short existence. They were all possessed of such marked and distinct internal characters that we could not trace between them and associated or synchronous genera any evidence of the result of descent with modification, and no imperfections in geological record would come to our aid to clear away the difficulty. Therefore, although far from denying the possibility or probability of the correctness of the Darwinian Theory, we could not conscientiously affirm that the Brachiopoda, as far as we were at present acquainted with them, would be of much service in proving a theory, which, however delightful in its conception, had still to be made certain by positive and indisputable evidence, and it was a subject worthy of the continued and serious attention of every well-informed man of science, for the sublime Creator of the universe had bestowed on man a thinking mind, therefore, all that was discovered was legitimate. Science had also this advantage over theology, that it was continually on the advance, and ever ready to correct its errors when fresh light or new discoveries make such necessary. The importance of the study of the Brachiopoda was very great, when they remembered that they were among the they first well authenticated indications of life in this world, and that had continued to be very extensively represented up to the present time. They were also very abundant and characteristic fossils, by which rocks at great distances could be identified, and without its being even necessary for the Palæontologists to visit the district from whence they were derived, and as we became more intimately acquainted with their characters, their interest and usefulness was augmented. They were, as Mantell would have termed them, sure medals of the creation, with the date of their appearance firmly stamped upon them, and their distinctive characters so legibly impressed as to defy misinterpretation.

Mr. Davidson resumed his seat amid loud and continued applause. The paper was illustrated by beautifully designed and executed diagrams, by Mr Davidson himself, and specimens illustrating the Brachiopoda were exhibited. A hearty vote of thanks to Mr Davidson, for the trouble he had taken in the preparation of the paper read, was proposed by the Chairman, Mr Alderman Cox. He thought that a more than usually hearty vote had been well-merited. Asking pardon for digressing from the subject before them, he broached a tender matter by expressing how deeply he regretted that, for a time, Mr Davidson's services had been lost to the Museum). He, however, hoped that Brighton would still be favoured with the services of a gentleman whose name was known wherever the name of geology or science itself was recognised. The motion was unanimously carried.

The deep regret experienced at the loss of Mr Davidson's services to the Museum was about to be further commented upon by Mr Alderman Mayall, but the Chairman interposed by remarking that he thought they had better not go into that subject, although he had been allowed to revert to it. Mr Alderman Mayall then paid a tribute to the great care with which Mr. Davidson had investigated science, and asked that gentleman whether, in any of the dredging expeditions, extinct genera had been re-discovered.

Mr. **Davidson** replied that he had had several letters from the Challenger Expedition, and had seen all the forms discovered in the course of the other expeditions—he, in fact, had been asked to describe the Brachiopoda obtained by the Challenger Expedition, having done so for various expeditions—and not a single extinct form had been found. In reply to the Chairman, Mr Davidson further stated that he had 40,000 specimens, from every part of the world, and fully four-fifths of the known species.

Mr. **Wonfor** observed that the geologic story as told by the Brachiopoda did not bear out the theory of evolution. Besides the fact that when the genus disappeared it never reappeared, one could hardly imagine that *Tretenterata* with a mouth and anal opening degenerated into the *Clistenterata* with a mouth but no anal opening. In the latter, one aperture had to perform the double office of mouth and anus, and in the former these functions were performed by two apertures—an evidently higher type than the other.

Mr **Haselwood** reminded the meeting that this theory of evolution was only a working hypothesis, and one of the best which they had. He also took this opportunity of remarking that they could not over-estimate the value of such a gentleman as Mr. Davidson. If the world was to progress, it was by such devotion as his, and by that alone; and when a gentleman of his means and capacity would set apart his valuable life to a seemingly out-of-the-way subject like this, and proclaim such facts as those to which he has given utterance that night, no man was more worthy of the praise and honour of his fellow men.

In answer to Mr PANKHURST, it was pointed out that the Brachiopoda served a purpose in the animal economy. They constituted food for other animals, and were even eaten by some in America. Several other gentlemen engaged in the conversation. At its close, the specimens exhibited by Mr Davidson were examined with interest.

FEBRARY 25th.

THE ANNUAL SOIREE.

The 4th Annual Soiree was held at the Royal Pavilion, the whole suite of rooms being engaged for the occasion, and proved none too large for the gathering of members and their friends, which numbered between 700 and 800.

The Banqueting Room, two Drawing Rooms, and Saloon were devoted to a variety of interesting objects, while the Music Room was converted into a dark room in which short quarter of an hour lectures, illustrated by the magic lantern, were given at intervals during the evening.

The exhibition of objects of interest was not only more varied than on former occasions, but in many cases unique. In the North Drawing Room, the Sub-Wealden Exploration was brought prominently under notice, Mr. Ernest Willett here presiding over cases in which were shown a number of the latest cores extracted from the bore hole, as also those which were brought to the surface just prior to that unfortunate breakdown, with the particulars of which the public had been already informed through the reports of Mr. Henry Willett, F.G.S., the Honorary Secretary to the undertaking. During the evening, the cores were eagerly and studiously scanned. Close by the Sub-Wealden cores, Mr. Ernest Willett exhibited the bones and flints which he found during his excavations at the

Cissbury pits, and respecting which he read a paper before the members of the society.

A fine collection of shells, some of them beautifully marked, was exhibited by Miss Glaisyer.

In the Saloon, the cases of stuffed birds lent by Mr. E. T. Booth at once attracted attention. With respect to these, it was, as Mr. Wonfor remarked in the course of the evening, difficult to tell where "Nature ended and Art began." While the natural features were well preserved, Art came in to aid in the accurate representation of the surroundings. The birds exhibited formed part of a magnificent collection which Mr. Booth has formed. They had all been shot by himself and are, eventually, to be place in a permanent building, which has been erected especially for their reception, on a piece of ground abutting on the Dyke road. Every bird in the collection is shown with something of its natural surroundings at the time of the capture. This has been done by sketching the spot and afterwards reproducing it by means of modelling. The mounting is entirely artificial; but is, nevertheless, wonderfully realistic, and this even in the most minute detail. Regard being had merely to those cases shown in the Saloon, it might be said truly that ornithology never found a more artistic and complete exemplification. Whether one looked upon the owls taken at Chiltington, the moor hens obtained on Loch Glyn, in Ross-shire, or the specimens of the cuckoo, the wagtail, and other members of the feathery family taken in the vicinity of Brighton, there were still to be seen the botanical productions peculiar to each, while the geologist, would find it difficult to discover a defect in the character of the strata in each case represented. Mr. Booth has made a special study of the subject; and, no expense being spared, he has, by dint of great labour, succeeded in getting together the unique collection of which he is the fortunate possessor. A specimen of the great African Albatross, together with a pair of splendid lyre-birds, supplemented Mr. Booth's collection. These latter were exhibited in the Drawing Boom by the President of the Society (Alderman A. H. Cox, J.P.)

In the South Drawing Room Mr F. E. Sawyer had a large collection of meteorological instruments, weather charts, and other appliances for the study of the atmosphere and its effects. Apparatus for the analysis of milk, and the detection of adulterations in that necessary article, as well as specimens of its affinities, were shown by Mr. E. Moore, amongst these being some of the artificial milk used for feeding infants during the siege of Paris. Close by was placed the tank of the Aquarium Company. Special arrangements as to lighting, &c., had been made for the exhibition of its contents; and Mr. Lawler certainly had no unattractive collection. Here was a specimen of the sea anemone—a double dianthus—with two mouths, two sets of tentacles, but only one body! A similar "freak of Nature" had also happened in regard to a baby trout, hatched in the Aquarium. Coming from one ova, it had a veritable Siamese twin appearance; and, as it was carefully held up to view in a glass bottle, its two heads presented a very peculiar appearance as they converged to the centre and terminated in a single tail. A number of tiny salmon were also shown, and the sea horses in the tank, together with anemones, tube worms, zoophytes, madrepores, all gracefully exposed among rock-work and sea-weed, furnished a noteworthy contribution.

Electrical experiments were provided by Mr J. P. Capon, who had a powerful battery at work, and the kaleidograph, lent by Mr. G. Nash, was a never-ceasing source of fascination. Amongst the more general collections were skeletons of turtles, one of which before death weighed 80lbs, exhibited by Mr Mutton; sections of telegraphic cables, including portions of the deep sea cables of 1865 and 1866; curious opium pipe from China, from the Grammar School Museum; a pipe fish exhibited by Mr W. Saunders, and other curiosities.

In the Banqueting Room Mr. Dowsett exhibited three fine cases of beetles; Messrs Wallis and Clayton exhibited an interesting case in which were an iron Crucifix found in the ruins of Lewes Priory; a pipe of the time of Cromwell, antique silver sugar tongs, spur of the time of Henry VI., dug up in the Queen's road, Brighton, mummy beads, mummy charms, a diminutive mummy crocodile, fossils found in the blue lias of Somersetshire, lent by Mr. C. E. Clayton, including paddles and jaws of the ichthyosaurus. A model of the link motion of a locomotive, lent by Mr. Mutton, a capital collection of eggs, and a portion of the jaw of the sperm whale, some six feet long, with most formidable teeth, from the Brighton Grammar School Museum, were also in this room. Mr. Hubert Saunders was a large contributor, and exhibited a dangura, or Himalayan wood axe, and a kookeree, or knife used by the Ghoorkas, and Arab slippers. Photographs of the natives of Steamer Point, Aden, and of the Point itself, calabash covers from Central Africa, flint implements from Cissbury, &c.

Spectroscopes, &c., were exhibited by Messrs. T. Rowley and Son, as well as a photorama and cuminoscope. Telegraphic and other apparatus were shown by Mr. Volk. Tree felling instruments in green stone, used by the natives of New Guinea, were exhibited by Mr H. Willett. The most interesting table in the room was that of Mr C. F. Dennet, who has devoted himself, and with the most encouraging and gratifying results, to the discovery of substitutes for cotton, silk, &c., and materials for the manufacture of rope, paper, and other things. He was led to this by the cotton famine in the last decade and by the reward offered by the Government; the result being that several growths which have, up to the present time, been regarded as all but useless have been utilized and have been found to yield well. Specimens of China grass, New Zealand flax, and other plants, in various stages of preparation were shown, and the fact that they are now finding a ready sale in the market is a satisfactory proof of the success of the experiment. Hitherto the chief difficulty in dealing with these products has been the want of a machine which should properly separate the fibre, and such a machine Mr Dennet has just managed to secure.

Microscopes, spectroscopes, galvanic batteries, meteorological and other scientific instruments, were scattered throughout the rooms.

Amongst those who presided over microscopes were Dr. Corfe, Dr. Tuthill Massy, Dr. Hallifax, Mr. Haselwood, Mr. W. H. Smith, Mr. Savage, Mr. Puttick, Mr. Wonfor, Mr. Ryall (Eastbourne), Mr. Wonfor, jun., Mr. J. Ridge, jun., Mr. G. D. Sawyer, Mr. C. Hamilton, Mr. T. Glaisyer, Mr Gwatkin, Mr. H. Saunders, jun., Mr. Lawler, Rev. W. J. Payne, Mr. B. Lomax, Mr. Mills, Mr. H. Lee (Croydon), Mr. F. E. Sawyer, Mr. Moginie, Quekett, and Mr. T. Curties (Royal Microscopical Society); the latter gentleman,—an honorary member,—in addition to supplying a large collection of tropical microscopical insects, also providing some two hundred mounted objects for the use of members. The special object shown by Mr. Wonfor was a newly-hatched salmon, and by Mr. Lee the head of the well-known insect, the "Daddy Long-legs," beautifully mounted in glycerine.

Galvanic batteries and electrical apparatus were exhibited by Mr. Benjamin Lomax, Mr. J. Capon, Mr. R. Glaisyer, and T. Cooper.

At half-past eight, the PRESIDENT, Mr Alderman Cox, delivered an inaugural address in the Banqueting Room. It was a rule of the Natural History Society that, at the annual soirée, the President and other members should deliver short addresses. For the sake of the assembly, as well as his own, he was glad to say that ten minutes was the usual time allotted. He recollected the distinguished ability of many of the gentlemen who had preceded him in the chair which he had now the honour of occupying; and he had always felt it to be somewhat presumptuous in his venturing to accept an office which was pressed upon him by those who had too favourable an opinion of his attainments. He knew that their society had amongst its members nearly all the scientific men in Brighton. He also knew that on these occasions they were proud of the company of many young persons and ladies who had not made natural history their particular pursuit. It was to those he wished to address his few remarks; for he desired to create in their minds an intelligent interest in the pursuits of the society and the specimens of natural history in the museum. He was not going to trouble his young friends with any technical phrases, but perhaps in one of the rooms they might have observed lumps of granite. These were called primary rocks; they were crystaline in their character, broke like pieces of lump sugar, and when broken showed no signs of either vegetable or animal life. They were most durable in their character; but, like everything in creation, they were subject to change. Jersey was built upon the primary rocks, and at places might be seen large masses which had become displaced, and nearer the seashore smaller pieces. As the tide rose and fell, ebbed and flowed, those pieces were rubbed the one against the other, and fine sand was formed. After the lapse of ages, this sand became a sedimentary rock; they were stratified; they broke into layers, and did not break, like the primary rock, into crystaline masses.

Some of their pavements were composed of this species of stone, and most valuable it was for building purposes. He did not allude to the Caithness stone, some specimens of which might be seen near the Post Office. That was mud consolidated by the lapse of ages, and in which had lived and died myriads of creatures, the oil from whose bodies gave it that greasy appearance so observable. Coming to a more recent formation, it would be seen, when passing through Clayton Tunnel towards London, they came upon a large expanse of comparatively flat country. This was an estuary of the sea, in which a mighty river once poured its flood and deposited its mud. This extended over a large district which existed where the English Channel now was, and could be distinctly seen on the opposite coast. After passing through the wealden district they came to the north down, composed, as were the south downs, of chalk. Unquestionably, the north and south downs were connected, and covered the space where the wealden clay now existed. This chalk extended to London and beyond; and as all chalk was formed at the bottom of the sea, it followed that where London now stood the sea once ebbed and flowed. The hills surrounding Brighton were of chalk, and the London and Lewes roads were the valley through which rivers ran. Within their own time they might see some of these changes. Thirty years ago he visited Offham chalkpits to collect specimens. Barges for the conveyance of the burnt chalk or lime were brought to the foot of the hill. Last summer he was there; and the barges could not approach within half a mile of the same place; that which was covered by water had become dry land. Above the chalk the London clay was found. That formation cropped up in their own neighbourhood, and in it had been found many plants now grown in tropical regions. He had omitted any reference to the intermediate strata. Did time allow, he would call their attention to the carboniferous, in which coal was found—the vegetable remains of a past time. Buckland said that, in the coal mines of Bohemia, the most elaborate imitations of living foliage upon the painted ceilings of Italian palaces, bore no comparison with the beauteous profusion of extinct vegetable forms with which the galleries of these instructive coal mines were overhung. The roof was covered as with a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild irregular proprofusion over every portion of its surface. The effect was heightened by the contrast of the coal black colour of these vegetables with the light groundwork of the rock to which they were attached. The spectator felt himself transported, as if by enchantment, into the forests of another world; he beheld trees, of forms and characters now unknown upon the surface of the earth, presented to his senses almost in the beauty of their primeval life; their scaly stems and bending branches, with their delicate apparatus of foliage, were all spread forth before him, little impaired by a lapse of countless ages, and bearing faithful records of extinct systems of vegetation which began and terminated in times of which those relics were the infallible historians. He had attempted, he knew most feebly, to describe those physical changes; he would now briefly remind them that in accord with those changes different grades of life appeared. The earlier formations showed but a low order of either animal or vegetable life, and it was only in the later geological epochs that they saw the higher order of life, with its higher development and its more exquisite sensibility to the joys and pains of existence. Some of their kind friends had brought their microscopes, and they would show them that the lower order of life had its organization perfect for the circumstances in which it was placed, and the various clusters of contrivances showed the power and wisdom of the Great Creator. The microscope would also show that there were other worlds beside our own, for it was well said by Channing that, "whilst the telescope revealed a world in every star, the microscope revealed a world in every leaf," and so minute were some of the little creatures formed, that no less than 41 millions were found in a cubic inch of tripoli, or the polishing slate. Millions and millions of years had elapsed to produce those changes, but how manifest through all those countless ages were shown the power and wisdom of God in the works of His creation? One more word and he had done. Let them not neglect to see the spectroscope. They would see every gas and liquid examined by it showed its own lines of colour and coloured liquids, exactly alike to the naked eye, had a marked difference when subjected to its influence. His task was done, and he thanked them for the attention with which they had listened to him; and if he could induce one person to join the Society and feel an interest in the contents of the Museum, he should be more than satisfied. He could assure them they would meet with enjoyments unalloyed with regrets; and he believed they would feel as he felt, under deep obligations to those who had established the Society, and that their warmest thanks were due to their excellent Hon. Secretaries, Mr. Onions and Mr. Wonfor, who had been most active in preparing this intellectual treat for their enjoyment.

Mr. **Wonfor** then gave a brief epitome of the contents of the rooms, the object being to direct the attention of visitors to particular places for particular features. Referring to the tank of specimens lent by the Aquarium Company, he said that, although some people out of Brighton sneered at the Aquarium, and said it did nothing to aid science, those in Brighton knew the Company did everything in their power to aid the progress of science, and, perhaps, he might, before many months were over, tell them what he thought the Aquarium had done for the cause of science.

An adjournment was now made to the Music Room, where, before a large audience,

Mr E. A. **Pankhurst** lectured on "The Forms of Water," his remarks being illustrated by a magic lantern. He proposed to consider, for a few moments, water under the three forms in which it presented itself to us, viz., as a gas, a liquid, and a solid, and he would commence with the form best known to us—the liquid. Here they had (referring to a slide exhibited on the screen) a view of a clear, pellucid lake lying in its solitary beauty among the Sierras of California: it was the mirror lake of the world—renowned Yasemite Valley. How marvellously clear it was, how truly it deserved its name, for not a feature of those hills was in the mirror slighted. But it was not of its beauty that he wished to speak to them so much as its power. It was strength in repose; it was power potential, not active. Follow the stream that ran from it down the valley. Here the giant was enclosed, and in this view of the Lower Falls they beheld a picture of the work which it had done and was still doing. For thousands of years it had been eating away the hills, and in the photograph of the Yasemite Valley itself—the stream running 6,000 feet beneath the peaks on either side—they saw what a memorial it had left behind it of the work it had done. Or if that example of the force of water drew too much upon their imagination, let them stand on the brink of Niagara, and gaze at the swirling, surging torrent hurl itself into the abyss below. The world scarcely furnished a more impressive spectacle. Whence did these lakes and rivers have their source? The answer was, in the rain that falls on the earth. The rain came from the clouds; and the clouds, whence did they arise? These masses of vapour were creatures of the earth, born of the land, the rivers, and seas. They could not follow them in the passage from earth to sky, for steam was invisible. By means of heat water became an invisible gas. It issued thus from the tea-kettle, or the chimney, or the locomotive engine. But, at a short space from its source, it was condensed by the colder air, and they had the dust of water as Tyndall called it, which was somewhat incorrectly termed "steam." It was the heat of the sun which caused the water of the earth to pass into this invisible gaseous form. By reason of its lightness it rose through the heavier air till it condensed into clouds. The canopy of clouds that so often hung above might not be very high. It was his privilege once, during an ascent of Mont Blanc, to be above the clouds, and to see the sun rise on the other side of them. Even there, the ubiquitous photographer had been. But the scene, beautiful as it was, could not give them all the glories of the reality. A sea of vapour threw its fleecy waves around the rocks at his feet. Far as the eye could reach it stretched its flocculent billows, and the great black peaks of the surrounding mountains were set as islands in its midst. The sun, gradually climbing above the horizon, flooded by degrees the depths of its ghost-like waves with mystic light, and edged their crests with silver. But this mass of vapour, if at a greater elevation, would not fall in rain, but would be congealed to snow.

They had seen lately those white flakes of frozen vapour coming down in multitudes. How many of them dreamed, as they fell around, of the beauty of their geometry? Here were examples of some of the "snow flowers;" they would observe that each one had six petals, and though the forms were so various, the number was invariable. In Brighton the snow did not last long, for the heat soon converted it into liquid, and as such it found its way into the sea. But on the summits of the Alps it was not so; there the cold was too great. Not all the snow that fell was melted, only a portion. Were it to be piled up from year to year, in a century the Alps would have nearly 4,000 feet of snow on them. But they would see, by the view of Monte Rosa, that the great stormy peaks still cropped up above them. What became of it then? It slid down the sides of the mountains and filled up the valleys. But in doing that a great change was effected in it. They knew that, after walking in the snow for some time, the bottom of their boots was covered, not with snow, but with an icy mass. The pressure on their heels had generally hardened a frozen lump there. They learned the important fact that pressure could convert snow into ice. It was so in the Alps. The vast superincumbent masses of snow pressed that beneath it into the narrow valley, and so formed what was called a glacier. It was somewhat difficult to describe a glacier, but they might imagine a huge river winding among the hills, its surface rugged with the vast waves which a stormy wind had raised on it, and then imagine that, in a moment, the river was frozen. The crests of the waves were ridges of ice. The depressions between them ran down for hundreds of feet. Such was the great ice river called a glacier. Amongst researches of scientific men during recent years, few had more interest than those of Agassiz, Forbes, and recently Tyndall, on the subject of glaciers. To the works of Pro. Tyndall on the "Forms of Water," from which he had borrowed the title of his lecture, he would refer those wishing to know what there was to be said on snow and ice. One would scarcely think such a mass of rigid ice moved, but it had been proved that it moved just as a river, faster in the middle than at the sides, faster at the point towards which it bent than that from which it turned. In fact, a glacier did everything that a river did, and they had often had melancholy proof of their movement. Glaciers were the sources of rivers; the Rhine, the Rhone, the Oregon, and others had their sources in them. The hot summer melted them as they came down into the narrow valleys. The water trickled through the cracks, plunged into their crevasses in hundreds of little cataracts, and at last found a vent at the bottom of the valley. But the Alps were not the only mountains where there were glaciers—the stupendous peaks of the Himalayas were surrounded with them. In the midst of their inaccessible peaks could be discerned the glittering of the great ice rivers. How they dug out the valleys and polished the sides of the mountains between which they moved. How they carried down to their termination the huge boulders which had fallen from the mountains upon their surface during their journey, and, when they melted, left them stranded on the plains. The hills and valleys of Scotland and Wales still bore marks of the great glaciers which had passed over and along them, and the "scars of Cumberland and Westmoreland still showed where the irresistible ice plain had passed along.

In conclusion, he wished to say a word or two more, particularly with regard to ice. Were it not so common, how wonderful it would be to see clear liquid water turned to brittle, crystaline, solid ice. But in England, Nature was not seen exerting her crystalising power in all its grandeur. If they wanted the poetry of frost they must go to Russell, Lovell, and to Emerson, and, looking at such forms, they could well understand the beauty that had inspired those American poets. But how was ice built up? The skaters, hurrying over the glossy surface, little thought of the wondrous forms of which every portion was built up. Still true to her plan, Nature never varied from the hexegon. Why that necessity so often constrained her, Science could not answer. Often during the frost preceding Christmas he had wished for the aid of the photographer to render permanent the evanescent forms on the windows. Those delicate graceful forms seemed to rival Nature's beauty of leaf and flower. They could think for a moment of the wonderfully complex forces of which they were built up, of the power, at once impelling and restraining, that had drawn such a curve, as with a master's hand, but they could know nothing of Nature's method in her artistic movements. Perchance she would keep the secret always hidden, or perhaps some day Science would throw open the door, and they would see the manipulation of the artist, but at present they could only admire that which was at once nature and art in one.

Mr. T. W. WONFOR lectured on "The Life History of an Insect," also illustrated by magic lantern views.

Strictly speaking, an insect consisted of three separate and distinct parts, head, thorax, and abdomen, and possessed six legs and one or two pairs of wings. The stages through which it passed were described as egg, larva, chrysalis, and perfect insect; there were exceptions to this general law, but generally the female laid her eggs, either in or on the food plant or animal of the future caterpillar or grub; in some cases she had an instrument by means of which she pierced the body or substance in which they were placed, and a wonderful instinct came in play, when, through the stem of a plant, she was able to deposit her egg in the body of some creature within the stem. The eggs, and the number laid by an insect, varied from a few score to some hundreds, were curiously deposited in the majority of cases on food differing essentially from that of the mother; she might be honey loving, while the grub was carnivorous; she might eat nothing during her brief existence, while the caterpillar would only eat certain plants. She must also guard against accidents, such as the fall of the leaf and glue, in the autumn, the eggs from which the larva would escape in the spring, to the stem of their food plant. All this she did, and much more besides, with what we, for want of a better name, called unerring instinct. Some insects, like the flesh-fly retained the eggs, which hatched within themselves, and laid the maggot ready to commence its work as a scavenger; others, like the blackbeetle, carried them in horny cases till the young fry were ready to escape.

The eggs themselves, often very minute, were objects of great beauty and variety, and though so small, far exceeded in marking and ornamentation any eggs belonging to any other order of animals. The shell consisted of three layers, an outer one, tough and raised, a middle one of non-nucleated cells, and an inner irridescent one. Internally, they consisted of a yolk membrane, the yolk substance, and the germinal vesicle. There was one part of the egg called the micropyle, or little gate, and some affirmed the larva eat its way out at this point, but his experience showed that at that part of the egg to which its head was nearest, the caterpillar escaped and made its first meal, in many cases off its egg shell. The eggs of many bird parasites were furnished with a lid which lifted, and in the case of some, especially the Mallee bird and black Indian peacock, when moisture fell upon the egg, certain leaf-like appendages folded back and protected the cover.

The next stage was the larva, very voracious, very destructive, and constantly changing his skin; this stage presented great variety of markings and colours, sometimes so closely like the food that inexperienced eyes could not detect them. Some larvæ were covered with hairs and spines, and some of these hairs possessed the property of inflicting great pain, for their sharp points penetrated the skin and set up a most irritating annoyance. Some larvæ like those of the gnat, mosquito, or whirligig beetle, lived in the water, and there, by eating decaying animal and vegetable matter, kept our streams pure.

When the caterpillar or grub had stored up sufficient fatty matter, it prepared to enter the next stage of its existence as a chrysalis. Some spun cocoons, others formed retiring rooms in the barks of trees so deftly as to defy the scrutiny of an ordinary eye; others hung down head foremost, or lashed themselves by silken threads to twigs and branches; while some buried themselves in the ground, until the time arrived to burst their bonds and appear as the perfect insect.

Here, according to the absence or presence of wings, their number and their nature, insects were classified. There was one point which often startled, viz., that the great bulk of the insect world did not in the perfect state, grow. As regarded the perfect insect there was much of interest,—the compound eye, the antennæ, organs of some sort, but of what naturalists were not agreed, stings, lancets, tongues,—each and all would take more time than was at his disposal. Marvellous were their powers of finding out the food for their young, and most marvellous was the attractive power possessed by the females of some creatures of drawing up numbers of the opposite sex from long distances.

A third lecture from Mr. B. Lomax, on "Spectrum Analysis," (illustrated by Browning's Electric Spectroscope) was to have been given; but, owing to a want of power in the battery which was to have illuminated the electric lamp, Mr. Lomax had to abandon the experimental part of his contribution to the entertainment, and confine himself to a few remarks on the nature of the study.

The rooms throughout were pleasingly embellished with a variety of rare plants and shrubs, lent by Messrs. Balchin and Nell; and, during the evening, light refreshments were dispensed by Mr. Booth to the company at a counter in the Banqueting Room.

MARCH 11th.

ORDINARY MEETING.

MR. C. F. DENNET ON "VEGETABLE FIBRES."

It was so much the fashion for the theologian and man of science to refer back to pre-historic times, men, and things, as a starting point for evidence and precedent of the verity of the subject on which he spoke, that he feared if he did otherwise he might be thought out of fashion, presumptuous, and lacking in reverence for the wisdom of the past. He would, therefore, refer back to the earliest of time-servers and workers as a fit reference for a textile fibrous lecture. He found in an edition of the Bible —"Translated according to the 'Ebrew and Greeke,' and conferred with the best translations in divers languages, with most profitable Annotations upon all hard places, and other things of great importance" (Barker, Printer to the Queen, 1599—276 years ago—Genesis chap. iii., v. 7,)—it is written, "Then the eyes of them both were opened, and they knew they were naked, and they sewed figge tree leaves together, and made themselves breeches." This was, he thought, about the first intimation on record of the utilization of vegetable fibres. This edition was known amongst old bookworms as the "Breeches Bible." So much by the way of preface to the paper, which, by request, he was about to read on the anniversary-day of the first London daily paper, 1702. On the specimens of vegetable textile fibrous materials now before them—which attracted so much attention at the recent soirée of the society, he should try to make the subject to which he had devoted years of attention, much money, and in which he had found good instruction and delight, agreeable to them in so far as the limited time at command for preparation and his feeble talents would permit his giving them some details respecting their origin, from the rude to the elaborate product of nature, and he might add, art; shewing their value and advantage to commerce, manufactures, and mankind—developing a new industry—and which had become a source of wealth as well as a benefit to the whole human family.

RHEA, OR RAMIE.

What was it? A textile fibrous plant, within the last few years introduced anew from British India to the European world, and now grown extensively in the southern and western Pacific States of America. The samples before them showed the whole process progressively.—1. From the root of the plant. 2. Stalk or stem. 3. The epidermis and fibre freed of the wood, gum, resinous, and glutinous matter. 4. The fibre separated and left in its purity and strength. Finally—bleached, carded, roved, spun into thread and yarn—woven into goods, dyed in a variety of colours. They would also observe some specimens of Kurachee hemp, American black hemp, flax, and jute, which had been treated in the same way; and some hemp, which he styled cottonised, for spinning, like cotton. This was much used as a substitute for cotton during the horrible American war.

China-grass, now well known in commerce, was a member of the *urtica* family. *Urtica nivea* of Wildenow (differing widely from the common stinging nettle, *urtica urens*), the Callooee hemp, Kalmoi or Ramie of Sumatra, though the fibre was very similar, and for all practical purposes was identical, was yet a distinct species of *urtica*, obtained from the *urtica utilis*, *urtica tenacissima* of Dr. Roxburgh, and was now making the tour of the world. Thanks to the active age in which we lived, and the inventive genius of man, we should soon hear of some further rapid strides in the improved treatment of cotton and this wonderful fibre.

A French journalist, in 1869, claimed the credit of introducing to European notice *L'Ortie de la Chine*, or the White Nettle of China, for one Father Voisin, a French missionary to the Chinese Empire, as the first person who made discovery of its practical utility, and presented it to the attention of the *Societé d'acclimatation of Paris*, 1844-5. It might be well to correct this impression. It was known that the *urtica nivea (Boehmeria nivea)* had been utilised for centuries in the Indian and Chinese Empires, where it was employed for its great strength and beauty—strength for fishing nets; utility and beauty for wearing apparel. "Kankhura" or "Ramy," of the Islands of Malay Peninsula, to which was given the name of *urtica tenacissima*, was introduced in 1803, from Bencoolen to Calcutta, where it was cultivated at the Botanical Garden by Dr. Roxburgh, and a considerable quantity of this species was brought to Great Britain by Captain Joseph Cotton. The Society for the Encouragement of Arts, Manufactures, and Commerce, awarded a silver medal to Captain Cotton for its introduction to their notice. The fibre was tested and pronounced of practical value, but fell into disuse for the want of proper appliances for manipulating and preparing it for manufacturing purposes. Cotton, too, at that time was plentiful and cheap, and the cost of importing the fibre from India told against it.

The late American war caused a famine in the cotton industrial worlds, and a want of that staple article, and all other texile fibrous materials, for the spinner and paper maker, either to be worked alone or as an admixture with wool, cotton, silk, hemp, flax, &c., &c., caused public attention to be turned to anything and everything which could be produced and made available for either of the uses mentioned. The fibrous substance now known in commerce are:—Rhea or ramie, or China grass, Japanese grass, Jute, New Zealand flax, Bamboo, Aloe, Yucca, Espartero or Spanish grass, Algerian, Egyptian diss grass, the various palms and canes, the agave or sisal hemp, oat straw, wheat straw, broom corn, corn-husks, hop vine, &c., without saying anything of the utilisation of wood pulp (for paper), which came prominently into notice, and commanded high prices. Scientific men and mechanical geniuses taxed their brains and skill to produce appliances, machinery, or a process to speedily manipulate and utilise the best, as well as meanest, of nature's products, and to make them available for the use of man:—at first the want of knowledge of the chemistry of the plant; second, the use and abuse in the employment of chemicals of the right sort, and in proportionate quantities to a given quantity of material in cleansing and bleaching, caused much provocation, discouragement, and loss. Fibres are sensitive, and have an affinity for that which is bad, like iron, which, in course of treatment, takes to sulphur. It had recently been truthfully stated that cotton, "if it is saturated with chromic acid, or with permanganate of potash, and subsequently washed, although the fibre presents no apparent change, it is found to be seriously weakened when treated with any alkali." They had seen tons of the best flax and hemp injured by unskilled men. Whilst a resident in France, he learned that the public documents of 1830 in the archives of the French Government were going to destruction, all arising from the improper use of poor material and the more imprudent use of chemicals. Mr. Plimsoll might find that the occasion of the loss of more than one good vessel per annum was from the use of cheap canvas, used-up duck and cordage, the fibre of which had been partially destroyed by acids. He had to return to his subject. Success crowned the efforts of some enterprising spirits —men of great enterprise—whom he could name, and the result had proved that vegetables fibres had been levelled up from the dust immensely, and now held their own as staple articles of commerce in the great markets of the world, were quoted day by day, like cotton, flax, hemp, or any of the essentials of life.

For instance, Espartero or Spanish grass, which in 1850 was little known, and considered of doubtful character, a drug in the market at 50s. the ton, now commanded eleven or twelve guineas, if to be had at all. Two hundred thousand tons would probably be a low estimate for the importation and consumption of "Sparta Grass" for paper making in 1873-4. On the New World side of the ocean, the ordinary broom-corn (of carpet brooms) which used to be plentiful at three to five guineas per ton, was now contracted for in advance of its growth, at £12 to £15.

If they ran their eye down the Mincing lane produce sales of almost any day, they would find 1,000, 2,000, or 3,000 bales "sold on the spot" at prices ranging from £15, £17, £20. Some marks and brands of jute, the product of good growers, excelling in quality, like Major Hallett's cereals, commanded premium rates in advance of arrival. There was no end to the uses to which this useful fibre was applicable. He had seen thousands and thousands of bales landed at Boulogne from London to go inland to the French beehives of industry.

New Zealand flax, *Phormium Tenax* had not made the headway that several other fibres had. It grew abundantly in all the districts, and in one place, wild in the woods; the Colony being so far distant and in a primitive state, they had not given the attention to it they ought. To get proper machines to manipulate and render it supple and the readier for manufacturing purposes, Dr. Featherston, the Agent-General for New Zealand, in London, had recently furnished his confreres with a quantity, and it was hoped they would soon have a happy surprise for them, in machines which would do the work as it ought to be done, and thereby revive a demand for and use of a very superior fibre for many purposes.

He was sorry to tell them, and it might be no news, that with so much of good alloted us, also came much of evil; good and evil ought not to go hand in hand together, but so it was; there were adulterations in textile manufactured goods, and the officials at Somerset House ought to have an eye to the adulterators as well as upon the grocer, baker, and other tradesmen. It required longer and nicer calculation to produce refined shoddy goods for wearing apparel to cover our bodies than to make wooden nutmegs to tickle our palates. Look at the glowing announcement (samples handed round) setting forth "as a well-known fabric, being all wool weft, and well woven, the shades dyed to suit the prevailing fashion at the leading watering places, and being ingrain colours, they are perfectly fast." A chief recommendation seemed to be they were perfectly fast colours! Perhaps the vendor thought his goods adapted to this watering place on that account? They now had cheap enough articles. But how good? Paper made of the meanest old worn out, washed out materials charged with kaoline or pipe clay and sizing to give it weight. Newspapers for a half-penny so rotten they would hardly hold together during one reading and scarcely bear a short mail route. Trousers made of shoddy and refuse jute yarns—"guaranteed all pure wool" for 13s. Japanese silks, full length and width, twelve yards for 12s. 6d. Silk-rep, "warranted all pure silk and wool,"—only demi-rep, well dyed shoddy and jute. Again—"Your attention is invited to our warranted all pure silk stuffs at 1s. 6d. per yard"—which was all stuff!—puzzling both seller and buyer to show where the silk came in; and in weft, warp, or woof, in most of the very attractive fast-coloured fashionable goods now filling the shop windows in every large city or town in the kingdom or on the continent. He believed the continentals had much to answer for; the neighbouring streets of Bowbells were filled with German and French manufacturers, agents taking orders by samples, competing with the British manufacturer—all making haste to be rich. A recent writer in a popular journal of large circulation said:—

> "Indeed a plea for cheating has been put forward in a popular print, to the effect that, cheat as much as we may, we do not altogether succeed. You get up, it might be said, your fine glossy linens, half lime, glaze, and cotton—you produce your showy prints that before they are washed look like fine silk, and after washing like a worn out rag—and you think that you are 'doing' the poor Indian ryot who buys of you, because of the good name of the British merchant. Pshaw! No English matron who ever bored a shopkeeper in choosing goods knows so much as the sly Indian peasant who can tell the value of a yard of piece goods, even to a strain of cotton in the warp or woof. The pleasant fact is that, in attempting to cheat, we do not cheat, because our opponents are,

like the Heathen Chinee in the American poem, a great deal too sharp for us. We find that these unsophisticated children of the East, if not so wonderfully wise as we are, have yet a great deal of

'That low cunning which in fools supplies,
And amply too, the place of being wise.'

If we had any just claim to the title, which is sometimes satirically applied to us, of a Christian nation, we might blush perhaps at being outdone in roguery by these simple heathens; as it is, we cry ''Tis a wicked world!' and put up with our failure."

There was another quite as an important consideration as the loss of money in the purchase of bad material, or the discomfort we suffered. We lived in a trying and changeable climate, and need to be warmly clad. There was but little warmth in shoddy or jute goods. Ask any physician if at any period of his long experience there ever was a time in which old and young suffered so much from sciatica, rheumatism, and nervous diseases as now. He attributed a vast deal of this suffering to the showy but *slop-shop* material employed to afford warmth to the body. What would a cotton spinner say or do if his cook sent to his table to satisfy his appetite a round of boiled beef served with leeks, apples, and woody blackberries—with a tart composed of strawberries, onions, and stringy asparagus? It would be quite as consistent a procedure as some of the admixtures of fibrous materials he was sending forth to the world. He found he had diverged from his original intent: referring back again to the Ramie plant, it was introduced into America in 1867, had taken kindly to the soil of the Southern States, which was well adapted to it. The planters propagated it from cuttings, rather than the seed, which was common in India. It grew rapidly, yielded abundantly to the acre (and return in fibre); grew, indeed, like a nettle. Its fibre was contained in and protected by its stalk or stem. No caterpillar, "army worm," or insect, could injure it, like the cotton. It was proved that its culture would afford a great profit, as it required less labour, less outlay, care, and anxiety than any other crop. It would bear all the heat that cotton would. In winter cotton died outright, being entirely killed by the frost, and must be replanted. Ramie was only killed down to the ground by frost, and as soon as the frost was over, the plant put out again. It was a perenial. Three crops a-year were obtained without replanting—the plant would be of great value to the South, if only for ropes, twines, and paper,—but it was too good for such purposes. When properly treated and bleached the fibre rendered a good test with the microscope, micrometer, &c., in the course of which the simple fibre of the Ramie had been compared with that of hemp, flax, cotton, and silk :—the relative result proved thus, the fibre of the Ramie was longer and more uniform than all the others, after that of silk it was stronger, offered greater resistance to traction and to twisting, napped well, was more elastic than hemp and flax, and even than cotton, which was more flexible in twisting. Ramie, in these respects, only yielded the palm to silk :—it had all the lustrous texture of wool or silk, took a sparkling whiteness when properly bleached; it could be worked into an innumerable variety of goods of any style or colour. It was a good poor man's crop, or a lazy man's crop; labour was easy, culture inexpensive. The American Government encouraged its culture, as well as Jute, which had been cultured and was now grown extensively. England, France, and Italy, also encouraged its growth by premiums and awards. It had been tried in France and Italy with success, and even in Ireland. It was a hardy plant, and he saw no reason why the flax of Ireland should not find a competitor in the Ramie as well as King Cotton of the South; it required only a small capital to start a plantation. The subject was worthy of more special attention than it had hitherto received in a practical way; for, beyond doubt, there was yet a prosperous future for the textile fibrous plants—more particularly for the Rhea or Ramie, which was fast becoming known, and a staple article of commerce, and could be employed for our use and comfort in many ways. For the reason that we were so far away from commercial and manufacturing districts, and knew so little of what was going on—excepting from what we gathered in the papers, which were rather reticent on such matters as he had brought before them—he had given fuller details than he otherwise should have done, thinking it of interest to them and the public too. He hoped he had not wearied them. Finally, when we read of the millions and millions of acres of the world which were employed in the growth of cotton and flax alone, of the men, women, children, and spindles employed in spinning textile fibres, it opened the eye of our minds a little. We read, "it is a wise man that makes two blades of grass grow where only one grew before; but what think you of Him the all-wise great Creator and Benefactor, who clothes the field with grass for the dumb beasts, and from the much hated and abused nettle family had given us a plant three times a year made up of innumerable tissues, threads from which were made fabrics to clothe our bodies, as well as giving us from another resource of the field day by day our daily bread. And, further, from the very refuse—the straw—that bore the grain was made a paper for the Bible in which it is written, " The heavens declare the glory of God, and the firmament showeth His handiwork."

The President, Mr. Alderman Cox, proposed a vote of thanks. They were sometimes asked what was the good of the Natural History Society, and he thought the paper they had just heard read was a very good answer. It was not often that the members of the society were able to bring before them subjects on which they were so thoroughly and practically conversant as Mr. Dennet was with the subject of vegetable fibres. To use an American phrase, Mr. Dennet had undoubtedly " struck ile," and no doubt before long Mr. Wonfor would be at him again for another paper. If Mr. Dennet would supply them with a series of specimens for the microscope, he thought a very useful and instructive evening might be spent in the examination of these fibres. Some of them hardly knew what shoddy was, and would like to examine it under a glass.

The proposition having been agreed to, Mr. Dennet briefly acknowledged it, and in doing so gave some further information with regard to the different kinds of fibres and the uses to which they could be put. He should be most happy to fall in with the President's suggestions, and if they would prove acceptable he should have great pleasure in handing over a perfect set of specimens for the Museum.

In reply to Mr. SAUNDERS, Mr. DENNET said there was not nearly so much warmth in fibrous materials as in wool or silk. If, however, worked up with good wool, such materials would prove both warm and serviceable.

Mr. WONFOR spoke of the efforts which had from time to time been made to turn sea grass, &c., to account, but without success, and asked if Mr. Dennet could not tell them something about the machine which was now being used for separating vegetable fibres, and which his modesty, perhaps, had kept him from saying much about.

Mr. DENNET entered into an explanation of the circumstances which led to his taking up the subject of the utilisation of vegetable fibre, and referred to the correspondence which had taken place between Dr. Forbes Watson and himself on the subject. Government had offered a premium of £5,000 for a machine which would separate the fibre without injuring it, but this was subsequently withdrawn, although he now had a machine which would do the work speedily, cheaply, and well, and at a very much less cost than another machine which had been brought out for the same purpose.

APRIL 8th.

ORDINARY MEETING.—MR. F. E. SAWYER ON "THE BIRDS AND MAMMALS OF SUSSEX."

At a meeting of this society, held about two years ago (on the 16th April, 1873), their excellent Secretary (Mr T. W. Wonfor) read a paper on "The Verification of the Fauna and Flora of the County of Sussex." This was considered by the President and all the members present one of the most interesting and important papers ever read before the society. He had therefore been somewhat disappointed at not seeing any actual results from that paper.

Now, he had always thought it to be an especial duty of local scientific, and literary societies and institutions to develope the local element to the utmost extent. For instance, to obtain, for local museums, complete collections illustrating the geology and the fauna and flora of the district, and, for libraries, complete sets of the works of all local authors and all books relating to the district. If this were done, a student of science and literature would know that, on going to a particular place, he could obtain complete information relative to that district, and an incalculable impetus would thereby be given to the study of science and literature. He had accordingly endeavoured in all previous papers he had had the honour of reading before the society to confine his attention to the county of Sussex. This, therefore, coupled with his disappointment at seeing no results follow Mr. Wonfor's admirable paper, had induced him to bring before them the present subject, in the hope that other members might follow him in endeavouring fully to work out the suggestions contained in Mr. Wonfor's paper.

The mammals of the county were not numerous, and this would not appear surprising when its geographical position was considered, and the fact that for nearly 2,000 years the county had been inhabited by more or less civilised races, and had also been partially under cultivation. The only list of Sussex Mammals he could find was that of Dr. Mantell, in the appendix to Horsfield's "History of Lewes," who enumerated the following:—Common bat, eared bat, common squirrel, dormouse, brown rat, common mouse, field mouse, water rat, harvest mouse, hare, rabbit, hedgehog, common shrew, common mole, polecat, weasel, badger, fox, and otter. The latter was stated as being rare, and found on the banks of the Ouse. This made a total of 19. No mention was made of the water shrew, stoat, field vole, and meadow vole, which were found here, or of the wild cat, which, as they had heard at a recent meeting, was a Sussex Mammal, though Mr Newman, in the *Zoologist* for March, 1875, still expressed a doubt whether the wild cat had ever been obtained in Great Britain, and wished for complete particulars respecting any alleged occurrence of that animal. Mr. W. Jeffery, jun., recorded in the *Zoologist* (p. 9,016), that an otter was shot in Pagham Harbour, on the 2nd March, 1864, and also in the same journal (S.S., p. 1,253), that there were otters at Burton, near Petworth, in the spring of 1868.

The porpoise was also omitted from Dr. Mantell's list, shoals of which at times frequented the coast. The appearance of a shoal was considered a sign of a storm. It was said they came in search of food, as the following extract from the Meteorological Diary kept at the Chain Pier, Brighton, showed—"July 4th, 1825. This part of the Channel has presented a mirror-like appearance, save where the surface has been rippled by shoals of mackarel, or here and there disturbed by the visible ascent of porpoises, seeking their prey among these delicious and elegant fish." It was not very clear from whence the porpoises came, but his opinion was that if they were a sign of storm, that it was in this way; a storm drove away the fish on which they fed, and they then followed, thus an appearance of porpoises on this coast would indicate a storm at a distance, and which might reach this country. It was a common saying that when porpoises swam to windward, foul weather would ensue within twelve hours. In an old comedy by Ravenscroft, entitled *Canterbury Guests; or, A Bargain Broken*, we read, " My heart begins to leap and play like a porpice before a storm."

Mrs. Merrifield mentioned in her "Natural History of Brighton" that, about the year 1833 or 1834, a large whale, 70 feet in length, was stranded near the Roedean Gate. On the 13th November, 1865, a whale (the subject of Mr. Cooke's picture) was washed ashore at Pevensey. The *Brighton Herald* recorded that on the 15th September, 1848, " a shoal of whales, seven or eight in number, was seen off Brighton, one or two miles off in the direction of Shoreham. Probably bottled-nosed whales."

In an interesting paper by Wm. Borrer, Esq., F.L.S., in the *Zoologist* for September, 1874, five bats, not mentioned in Dr. Mantell's list, were mentioned as found in Sussex. The Barbastelle *(Barbastellus Daubentonii)*, which Mr. Borrer had taken under the the thatch of summerhouses at Henfield. Natterer's Bat *(Vespertilio Nattereri)*, of which twelve were found on the 29th June, 1848, on taking off the ridge tiles off a roof at Cowfold, and on Dec. 4th of the same year one was taken from the roof of Cowfold Church. Mr. Borrer stated that Daubenton's Bat (*V. Daubentonii*) had been taken at Preston, near Brighton. A specimen of the Whiskered Bat (*V. mystacinus*) was found on the 5th November, 1848, by Mr. Borrer's servant, in his coal cellar, being suspended by the thumbs and not by the hinder feet. Late in June, 1845, one of these bats flew against a man's white smock frock in the day time, at Lindfield. The Noctula Bat (*V. Noctula*) was shot by Mr. Borrer at Henfield, on 26th September, 1841.

They might therefore summarise the mammals thus—19 mentioned by Dr. Mantell, to which must be added the water shrew, stoat, field and meadow voles, and wild cat, and the five species of bats referred to by Mr. Borrer, making a total of 29 land mammals, and of marine mammals there were the porpoise and the whales which had been stranded, the species of which he did not know. No doubt the wolf and wild boar were at one time found in this county, but the former was long since exterminated and the latter became extinct some time after. He might mention, before passing to the next branch of his subject, that the county was celebrated for two breeds of cattle, namely, the Southdown sheep and the Sussex oxen, but he did not know their origin; and, as it was probable that they were only improvements of breeds introduced here, they would hardly come within the scope of this paper.

He now arrived at his second subject, the birds of Sussex. The county, from its maritime position and its proximity to the continent of Europe had been the resort of a great many species of birds. One of the earliest of Sussex ornithologists was William Markwick, Esq., F.L.S., who resided at Catsfield, near Battle, and between 1768 and 1793 made many observations there respecting the birds of the county, which were mentioned in White's "Natural History of Selborne." He also compiled a catalogue of Sussex birds, which was published in the Transactions of the Linnean Society. The next was Mr. Thomas Woollgar, who was born in 1761 and died in 1821. He was a contributor to the *Gentleman's Magazine*, and to Dr. Smith's "English Botany," His manuscripts contained records of 180 species of birds which had been seen in Sussex. He had not seen the lists of either Markwick or Woollgar.

Dr. Mantell, in his Appendix to Horsfield's "History of Lewes," gave a list of Sussex birds, and quoted extensively from Woollgar; he only enumerated 70 land and 40 water birds—in all, 110. The most complete list was that of A. E. Knox, Esq., which was given at the end of his "Ornithological Rambles in Sussex," one of the most interesting scientific books ever published. Mr. Knox catalogued 249 Sussex birds. The last edition of his work appeared in 1856. Since that year, with the exception of a reprint of Mr. Knox's list in Mrs. Merrifield's "Natural History of Brighton," no list had been published. It appeared to him that in making a new list of Sussex birds, the simplest plan would be to take Mr. Knox's list as the basis, and make the necessary additions thereto. After a careful search, he found that the following birds, which had been found in the county, must be added. In each case the place and date and authority were given:—

Iceland falcon *(Falco islandicus)*. One. Mayfield, January, 1845. Ellman, *Zoologist*, p. 3,233.

Red-footed falcon (*F. vespertinus*). Rottingdean, 1851. Sharpe and Dresser, "Birds of Europe," part 1.

Tengmalm's owl (*Nyctale tengmalmi*). Holmbush Park, near Horsham, 27th March, 1857. Borrer, Z., p. 5,988.

Woodchat (*Lanius rutilus*). Preston, 4th May, 1866. Pratt, Z., S.S., 267.

Black-throated thrush (*Turdus atrigularis*). Near Lewes, 23rd December, 1868. Monk, Z., S.S., p. 1,560. The only one in Great Britain.

Dipper (*Cinclus aquaticus*). Near Rye, November, 1871. Gurney, Z., S.S., p. 2,848.

Alpine accentor (*Accentor Alpinus*). Two. Lewes, 26th December, 1857. Parker, Z., p. 5,958.

Blue-throated warbler (*Cyanecula suecica*). Near Worthing, May, 1853. Stephenson, Z., p. 3,907; near Brighton, September, 1855. Cavafy, *Naturalist*, 1853, p. 264; Worthing, April, 1858, Wilson, Z., p. 6,605; Brighton, October, 1862, Pratt, Z., p. 8,281.

Aquatic warbler (*Salicaria aquatica*). Hove, 19th October, 1853. Proc. Zool. Soc., 1866, p. 210.

Rufous Warbler (*Aëdon galactotes*). Plumpton Bosthill, 16th September, 1854, Borrer, Z., p. 4,511. Only one other has been obtained in Great Britain.

Grey-headed wagtail (*Motacilla neglecta*). Near Brighton, 27th April, 1861, Pratt, Z., p. 7,709. Also 27th April, 1871, Pratt, Z., S.S., p. 2,639.

Tawny pipit (*Anthus campestris*). Brighton, 17th August, 1858, and 24th September, 1864, George Dawson Rowley, *Ibis*, 1863, p. 37. Four subsequently obtained at Brighton. The only other specimen taken was at Scilly.

Richard's pipit (*A. Richardi*). Near Brighton, 20th January, 1865, G. D. Rowley, Z., 9,466, and several others taken subsequently near Brighton.

Scandinavian Rock pipit (*A. rupestris*). This was formerly supposed to be the water pipit, but E. T. Booth, Esq., who had shot more of them than any one besides in England, informed him that the true water pipit had never been obtained in England, and that the correct name was Scandinavian Rock pipit. It had also been called Vinous pipit, and Vinous breasted pipit. Between 16th and 20th March, 1867, Mr. Booth shot ten in the small salt pools at Portslade, and almost every year since he had shot some at Portslade and Lancing.

Short-toed lark (*Alauda brachydactyla*). Near Brighton, September, 1854, G. D. Rowley. *Ibis*, 1859, p. 330. Two others had since been obtained near Brighton.

Siberian lark (*A. Sibirica*). Near Brighton, autumn, 1869. Bond, Z., S.S., 1,984 and 2,022. The only one obtained in Great Britain.

Shore lark (*A. alpestris*). Eastbourne, 8th January, 1867. H. Taylor, in the *Field*, Z., S.S., 636. Several others had been taken in the country since.

Little bunting (*Emberiza pusilla*). Brighton, November, 1864. Gould, Proc. Zool. Soc., 1864, p. 377. The only one in Great Britain.

Rustic bunting (*E. rustica*). Brighton, 23rd October, 1867. Gould, *Ibis*, p. 128.

Serin finch (*Fringilla serinus*). Brighton, 20th June, 1859. Bond, Z., p. 7,105. Several since.

Rosy bullfinch (*Carpodacus erythrinus*). Brighton, September, 1869. Wonfor, Z., S.S., p. 1,918. Only one other in Great Britain.

Parrot crossbill (*Loxia pityopsittacus*). Bognor, November, 1859. Z., p. 6,929.

Red-winged starling (*Agelæus phœniceus*). Sidlesham, 25th December, 1863. Jeffery, Z., p. 8,951; also Hove, 21st March, 1866. Monk, S.S., p. 229.

Alpine Swift (*Cypselus melba*). St. Leonards, October, 1851. Ellman, Z., p. 3,330.

Pallas's sand grouse (*Syrrhaptes paradoxus*). Boxhill, near Pevensey, 29th May, 1863. Dutton, Z., S.S., p. 1,098.

American bittern (*Ardea minor*). Pevensey Marshes, 26th November, 1867. Dutton, Z., S.S., p. 1,098.

White stork (*A. ciconia*). Medmary Farm, Selsea, October, 1859. In Chichester Museum. *Brighton Herald.*

Black-winged stilt (*Himantopus candidus*). Bosham, December, 1855. Newman, Z., p. 4,946: also Trotton, 17th May, 1859. Knox, Z., p. 395.

Buff-breasted sandpiper *(Tringites rufescens)*. Sussex Coast, 1843. Bond. Z., p. 148.

Spotted sandpiper *(Tringoides macularius)*. Several near Brighton. Cavafy, *Naturalist*, 1854, p. 234: also Eastbourne, October, 1866. In collection of J. H. Gurney, jun.

Pectoral sandpiper *(Tringa maculata)*. Eastbourne, 1870. Harting, "Handbook of British Birds," p. 141.

Broadbilled sandpiper *(T. platyryncha)*. Shoreham, October, 1845. Borrer, Z., p. 1,394.

Bonaparte's sandpiper (*T. Bonapartii*). Eastbourne, November 12th. Bates, Z., S.S. p. 2,442.

Baillon's crake (*Crex Baillonii*). Near Eastbourne, 6th August, 1874. Clarke-Kennedy, Z., S.S., p. 4,159.

Bewick's swan (*Cygnus Bewickii*). Several near Brighton, winter, 1860. Erredge's "History of Brighton," p. 152. Mr. Booth saw some near Norfolk Bridge, Shoreham, during the severe winter, 1870.

Hooded merganser (*Mergus cucullatus*). Burton Park, Petworth, Yarrell, "History of British Birds," vol. iii., p. 387.

Whitewinged black tern (*Sterna leucoptera*). Near Newhaven (a male), spring, 1872 or 1873. E. T. Booth, Esq.

Buffon's skua (*Lestris Buffonii*). Donnington, near Chichester, October 1873. W. Jeffery, Z., S.S., 3,823.

Greater Shearwater (*Puffinus major*). Picked up dead under the cliff at Seaford, June, 1854. Formerly in collection of Rev. R. N. Dennis, but now in that of W. Borrer, Esq.

Water pipit (*Anthus spinoletta*). One near Worthing, and on beach near Brighton, August, 1864. Pratt, Z., 9,279. Messrs.

Pratt inform me that Mr. Dresser has recently identified these as true water pipits.

Fulmar petrel (*Fulmarus glacialis*). Brighton. Dead specimen washed ashore in 1858. Merrifield, "Natural History of Brighton," p. 179.

Wilson's petrel (*Procellaria Wilsoni*). Sussex. Bond, Z., 1843, p. 148.

This makes a total of 42 species to be added.

The following may be considered doubtful:—

Ross's gull (*Larus Rossii*). Pevensey, 1852. Ellman, Z., p. 3,388. Harting, in his list published in 1872, does not mention this one, and Mr Booth thinks it very doubtful.

Masked gull (*L. capistratus*). Off Brighton, February 25th, 1853. Morris' "British Birds." This gull is said to be a variety of the blackheaded gull, and is not mentioned in Harting's list.

White heron. One shot by Mr C. Bull. Horsfield's "History of Lewes." It is not stated whether this is the great white heron (*ardea alba*), and it is doubtful what bird is meant.

Bartram's sandpiper (*Totanus Bartramii*). Newhaven, between 1836 and 1840. In the collection of the late Mr. Wille, of Lewes, at the sale of his collection bought by Mr. John Dutton. Z., p. 9,118. There is much chance of uncertainty in the case of this specimen.

The Virginian partridge and Californian grouse have been found, but they were only strays from preserves.

The total in Mr. Knox's list was 249, to which the 42 before mentioned being added made 291, which with 4 doubtful, would be the total of Sussex birds. This was one of the largest totals of any county in England.

The Sussex birds might be divided into four classes,—extinct, resident, migratory, and accidental visitors.

Of the first class there were only two:—the chough (or Cornish red-legged chough) and the great bustard. Of the former, White said that it could be found at Beachy Head and all along the cliffs on the Sussex coast. Erredge, in his "History of Brighthelmston," said that it was common 60 years ago. The latter had long since been extinct, Knox mentioned having met with some very old people who in their younger days had seen flocks of great bustards on the Downs. The last one shot in Great Britain was in 1803.

The second class, the resident birds, numbered about 60. It was somewhat difficult to ascertain exactly which were resident and which were migratory, as some birds partially disappeared at certain seasons, but this number was probably nearly correct. The migratory birds (the third class) numbered about 76, might be subdivided into two classes,—the summer visitors, chiefly singing birds, and which were smaller and of more delicate form,—and the winter visitors, mostly aquatic birds, and which were larger and more hardy.

The summer visitors included most of the Sylviadæ, Motacillidæ, Anthidæ, and Hirundinidæ families. Markwick gave the following dates in connection with their arrival in and departure from Sussex :—

	First seen or heard.	Last seen or heard.
Swallow	April 7—April 27	Nov. 16
Sand Martin	April 8—May 16	Sep. 8
Martin	April 14—May 8	Dec. 8
Cuckoo	April 15—May 3	June 28
Nightingale	April 7 (earliest)	——
Swift	——	Aug. 11

In 1862 and 1863 Mr. Prince heard the cuckoo at Uckfield on April 7th; on April 8th in 1865; and on the 11th in 1850 and 1857. The nightingale had, however, been heard before April 7th, for Mr. W. Saunders mentioned at the first meeting of this society in 1873, that he had seen one in Sussex square, Brighton, on April 4th, 1871, and on April 6th, 1872. Mr. Monk stated in the *Field*, that on April 13th, 1872, nightingales were "on the beach under the bathing machines, along the whole length of the shore at Brighton." J. H. H. in Hone's "Every Day Book" stated that on April 5th, 1826, two swallows were seen at Southover, near Lewes. The hoopoe might also probably be included in the Sussex migratory birds. It arrived in April, and had been obtained in September. The hoopoe had twice built in the county—at Park

End, near Chichester, and at Southwick. Mr. Wonfor also recorded in the *Zoologist*, for 1869, that a young hoopoe, evidently a bird of the year, was shot at Preston.

The winter visitors included the fieldfare, redwing, and several of the Scolopacidæ and Anatidæ families. In connection with these, Marwick gave the following dates:—

	First seen	Last seen.
Snipe	Sept. 29—Nov. 11	April 14
Redwing	Oct. 1—Dec. 18	Mar. 21
Woodcock	Oct. 1—Nov. 1	April 11
Fieldfare	Oct. 13—Nov. 18	May 1

Morris stated that the woodcocks arrived early in flocks of 20 to 30 near Brighton, and were to be found on the Downs for a short time amongst the furze.

Amongst the accidental visitors was the white-tailed eagle, of which several immature specimens had been shot. One at Arundel Park in 1858, one at Windmill Hill, Worthing, in January, 1844, a bird of the year shot on November 8th, 1868, at Compton Wood, Firle Park, by Viscount Gage's keeper, and recorded by Mr. Wonfor in the *Zoologist*. The only adult specimen in Sussex was seen by Wm. Borrer, Esq., between Brighton and Henfield on January 26th, 1865 (*Zoologist*, p. 9,465). Markwick in his list of Sussex birds included the golden eagle (*aquila chrysaetos*) but Knox thought that it was incorrect, and that a white-tailed eagle was seen and mistaken for a golden eagle. In Mantell's list the golden eagle was said (on the authority of Woollgar) to be found in the "Vicinity of Lewes over the Bray mount. One was killed at Bexhill a few years ago." The latter was the one referred to by Markwick, and was killed before 1795. Several ospreys had been obtained in the county. The Peregrine falcon was said to breed at Beachy Head and Newhaven. The rough-legged buzzard and honey buzzard, and the marsh hen and Montagu's harriers had been obtained. The eagle owl was shot at Hurstmonceaux on December 29th, 1784 (Latham's "Synopsis," 1st supp.) The scops owl was shot at Shillinglee. In July, 1842, a little owl was on sale at a poulterer's in Brighton market, said to have been shot in an orchard at Sheffield Park. These were the only records of the occurrence of these three species of owls in Sussex. Several great grey shrikes and pied flycatchers had been taken. The latter was a frequent summer visitor. The golden oriole was of rare occurrence; besides those mentioned in Knox, one was shot at Preston by Mr. Pratt, on May 4th, 1866 (*Zoologist*, S.S., p. 267), and one was picked up dead at East Grinstead, May 14th of the same year. Several specimens of the black redstart had been taken. The fire-crested regulus was shot near Brighton, January, 1869, (Wonfor, *Zoologist*, S.S., 1513), two were shot at St. Leonards on April 9th, 1869 (*Zoologist*, S.S., 1683). Knox stated the bearded tit had now become rare. The Bohemian waxwing was shot in January, 1848, at Newhaven, and others have been obtained in the month of January. Three wagtails were shot by Mr. Swaysland, at Hove, in April, 1853. The crested lark was shot at Shoreham, October 20th, 1853. (S. D. Rowley, *Ibis*, 1864, p. 224). The crossbill had been seen several times, and it had once nested in the county. Of the rose coloured pastor, two were shot by a farmer near Brighton, on August 20th, 1870 (*Zoologist*, S.S., p. 2,344) One specimen of the nutcracker had occurred; the bee-eater was shot near Chichester, May 6th; 1829. The little bustard had once been obtained. The purple heron was shot at Worthing, on April 28th, 1848. An adult male of the little bittern was shot at Runcton, near Chichester, on April 11th, 1869. The avocet was now rare, Markwick stated that in his time it was not uncommon on the coast. The gray phalarope appeared in unusual numbers in 1866, they began to arrive in the third week in August, and continued to the second week in October, and during this period 250 were taken in Sussex! The purple sandpiper is frequently found at Eastbourne, and Mr. Dutton thinks it is a regular winter visitor. The Sclavonian grebe was taken in a garden at Worthing, on March 7th, 1865, (Gurney, *Zoologist*, p. 9,540). The black-throated diver and red-breasted diver have been found. The common guillemot and the razor-bill are said to breed at Beachy Head. Several specimens of the fork-tailed petrel had been taken after heavy gales in November, and have been picked up dead on the sea shore.

There were not many proverbs or superstitions in connection with birds in the county. It was said that "the old woman takes the cuckoo in her basket to Heathfield Fair and there turns it out." Heathfield Fair was held on April 14th, and about that day the cuckoo arrived in Sussex. In White's "Natural History of

Selborne" it was stated that "The people of Sussex call the missel bird the storm cock, because it sings early in the spring, in blowing, showery weather." At Chichester the appearance of a cormorant on or about the Cathedral was said to presage the death of one of its dignataries. The *Brighton Herald* said that, "On July 29th, 1836, a cormorant appeared on the north wall of the City and was shot. They have been known to settle on the weathercock of the church, being a convenient resting place. It is remembered by many that a cormorant appeared on the Cathedral previous to the death of Bishop Ashburnham."

Since writing the paper he had discovered in the library a list published by the Eastbourne Natural History Society, which contained the following eleven birds:—Gyr-falcon, goshawk, great sedge warbler, rock dove, Barbary partridge, harlequin duck, black guillemot, roseate tern, noddy tern, sooty tern, and Bonapartian gull. He had, of course, been unable to make enquiries about these birds, but as regarded the first (the Gyr-falcon) Harting stated that it had never been obtained in Great Britain. The Eastbourne Society enumerated 260 birds found in their district.

In conclusion, he had to acknowledge the kindness of W. Borrer, Esq., E. T. Booth, Esq., and Messrs. Pratt in furnishing him with information, and particularly to thank Mr. Wonfor for allowing the birds to be brought out of the Museum to illustrate his paper.

The **Chairman**, Mr. J. E. Haselwood, Vice-President, invited the meeting to pass a vote of thanks to Mr. Sawyer for his able paper. He also congratulated Mr. Sawyer upon varying his professional labours by such study and research as had resulted in the paper read.

Mr. **Wonfor** reminded the meeting that Mr. Sawyer's paper was the first outcome of one he read two years ago; and he was obliged to Mr. Sawyer for coming forward as he had, and so assisting in removing the slight from them—the mother society he might say—that they were behind other societies of the county in making lists of mammals and birds. He also took this opportunity of remarking that of the mammals mentioned by Mr. Sawyer, the Museum was deplorably deficient, in specimens of the brown rat, black rat, common mouse, shrews, dormouse, mole, otter, harvest mouse, pole-cat, martin, and water-rat. Of bats there was only one. He solicited the assistance of members in supplying the deficiency, the Museum being much resorted to by natural history students. Before concluding, he threw out a practical suggestion to Mr. Sawyer, by the adoption of which he might be enabled to compile a complete and valuable list of the names and particulars of the birds of Sussex, of which there were a very large number, the county being favourably situated for the place of arrival and departure of migratory birds.

Mr. C. F. **Dennet** also pleaded on behalf of the Museum, and personally thanked Mr. Sawyer for his paper.

Mr. G. D. Sawyer and others likewise took part in the discussion.

April 27th.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON "FLEAS."

In consequence of domestic circumstances, Mr. C. F. Dennet, who was to have read a paper on "Vegetable Textile Fibres, microscopically considered," was unable to be present; and in his absence,

Mr. T. W. **Wonfor** made some extemporaneous remarks upon a flea new to science, received since the last meeting, from Mr. Curties, of Holborn. In a letter received from Mr. Curties he said "Since I shewed the Ceylon fleas at your *soirée*, Mr. Westwood has raised them from the pulex and ranks them with the chigoes, and as I have given the Society specimens of the former I will add to the cabinet the latter; some day I may be able to give you a portion of the skin; showing the creatures *en masse*." Its chief peculiarity was that it attached itself to the eyes and neck of domestic fowls. In some respects it resembled the chigo and in some the common flea, but, unlike the former, did not bury itself in the body of the animal to which it attached itself. The name proposed for it, regarding its more prominent habit, was the *sarcopsyllus gallinaceus*. As there were specimens of the chigo in their cabinet, he might explain in what respect this new flea differed from them. The chigo was a very dreadful fellow; having a habit of inserting itself into the skin round about the nails or any exposed part of the body. When the female wished to lay its eggs, it inserted its body into the flesh of whatever it attacked. This caused no irritation at the time; but, soon after, the insect increased enormously in size, and, unless carefully removed, would cause a very troublesome ulcer; in more than one case having led to the amputation of a limb. The negro-women in South America were exceedingly skilful in removing these fleas with a needle. Wallis in his *History of St. Domingo* reports that a Capuchin friar, who wished to bring away from that island a colony of chigoes, permitted them to establish themselves in one of his feet, as a present to the scientific colleges of Europe, but unfortunately for the cause of science, the foot mortified, was amputated, and with its inhabitants was committed to the waves.

Another matter of interest, which had recently come under his notice, had been furnished by the Rev. Mr. Aubry, who had showed him some specimens illustrative of the "developmental" theory, in connection with ticks. That gentleman brought him three specimens of ticks; the dog tick, red deer tick, and forest-fly. The first-named were wingless; the red deer ticks had abortive wings, or wings much resembling what those of the common fly would look like if snipped with the scissors; whilst the wings of the forest-fly were fully developed. In every other respect, as well as in their habits, all these insects were identical, so that, as far as the wings were concerned, the Darwinian theory certainly received an extraordinary illustration.

The meeting then became a Conversazione and proceeded to inspect the various slides of fleas shown by the members.

MAY 13th.

ORDINARY MEETING.—MR. T. W. WONFOR ON "THE BRIGHTON AQUARIUM: WHAT IT HAS DONE FOR SCIENCE."

It might fairly be said that in no branch of Natural History was there so much ignorance, even among those who professed a knowledge, as in that particular department which related to the life-history of marine life, whether animal or vegetable. There were plenty of manuals and very admirable treatises on the classification of marine zoology and botany, and capital works descriptive of the anatomy and physiology of fish, some of them containing very beautiful drawings of the animals described, but unfortunately they all dealt with the dead animal. None of them gave, from the actual observations of the writers, any description of the life-history, for the simple reason that the authors, from no fault of their own, were unable to observe the animals they described in the element in which they "lived, and moved, and had their being." The wonder really was that men like Yarrell and others had been able to tell us so much as they did about some of the habits and peculiarities of the inhabitants of the deep.

So great was the ignorance of the learned in fish matters, that it might with the greatest safety be said, that before the Aquarium in Brighton was opened, it would have been difficult, if not absolutely impossible, to find half-a-dozen men in England, who could have told them anything of the life-history of the commonest fish of the sea, or been able, if an Aquarium upon a large scale had been placed under their charge, to have fed and kept alive half-a-dozen different kinds of fish. It was perfectly true that books in plenty had been written about aquaria, and that aquaria on a moderate scale had been managed, and much knowledge obtained about some forms of marine life, notably among sea anemones and some of the mollusca; but the observations were carried on in glass and stone jars and bottles, or in aquaria which held at most only a few pails of sea water or artificial sea water, which some, even now that aquaria of great size were being constructed, pretended to prefer to genuine sea water.

As with every undertaking for the advancement of science and natural history in this country, so with the endeavours to extend our knowledge of marine zoology, we were not indebted to public, but private, enterprise. He need scarcely remind them that the Brighton Aquarium was neither a Government institution, supported by a grant from the Treasury, nor yet a branch of the British or South Kensington Museums, built at the seaside, the better to enable the officers of those national institutions to become acquainted with marine zoology and botany, but that it was constructed by a private company and was managed by a board of directors, whose duty to their shareholders was, primarily, to pay as good a dividend as they possibly could—to do which they must attract the public to see and admire the fish in the tanks, if possible; but, if the fish were not in themselves a sufficient attraction, to induce people by other and extraneous means to visit the Aquarium —and in the second place to do their best to advance the cause of Science and Natural History, by enabling naturalists to study living animals in a manner far nearer to nature and their natural habits than it was possible to do with land animals, cooped up in the cages of Zoological Gardens.

He should not have said a word on this subject did he not know that the most absurd claims had been put forward by some scientific men, in regard to what they considered the duties of the Directors of the Brighton Aquarium to them, and also as somewhat of a reply to others, who affirmed that the management of the Brighton Aquarium thought more of music than of fish. As long as any large undertaking was carried on with the idea of making a profit, so long would it be the duty of the Directors to consider the best way of making it pay; and that they would make it pay, no one doubted, provided they encouraged the efforts of their energetic and novelty seeking Manager and Secretary, Mr. G. Reeves Smith. No man in England knew better than he how to place before the pleasure-loving visitors to Brighton an attractive bill of fare, and were it his purpose to dilate upon the great addition to the attractions of Brighton such an institution as the Brighton Aquarium was, he could not too highly estimate the tact, skill, and judgment displayed by Mr. G. Reeves Smith; but his business rather was with the scientific than with the popular and attractive features which had been added to the Aquarium, as to all similar institutions, such as the Zoological Gardens, the Horticultural Gardens, and the Crystal Palace. If, while making it pay, science was advanced, the scientific student, who contributed nothing to its maintenance beyond the entrance fee paid by the ordinary visitor, ought not to grumble or complain that they were unable to afford him facilities for study, which, by-the-bye, he did not obtain even in our National Gardens or Museums, unless, perchance, he happened to be one of the staff; but he should the rather rejoice that something was being done to enlighten mankind on the marvels of the deep. If experiments were required to be performed for the special advantage of those who would reap both glory and profit by them, they could hardly expect the directors of a private company to carry them out for their especial benefit. If students required facilities for watching development, or for pursuing histological enquiries, why did not those of them who were Fellows of the Zoological Society bring their influence to bear upon the council of that society, and induce them to fit up tanks and attach to their own institution an aquarium and laboratories, where observations might be carried on for and by the fellows of that and kindred societies. He might add that, while he had not asked for any facility for study or observation beyond that which any student or visitor could obtain for himself, while walking through the corridors and watching the inmates of the tanks, he knew that scientific men of the highest eminence in their respective departments of science and natural history had been and were still being supplied with the material for carrying out and investigating problems of the highest character in matters relating to embryology, morphology, and histology.

In the management of the Grand Aquarium, where many hundred thousands of gallons of water were concerned, one of two plans had to be adopted to keep the water in a state conducive to the health and life of the inmates of the tanks, viz., either a circulation of water from tank to tank, or a system of aeration of each individual tank. In some places the former plan had been tried, especially in the small and easily managed Crystal Palace Aquarium, but at Brighton there were practical difficulties in the way of carrying out a perfect system of circulation: consequently aeration and the isolation of each tank was tried with a marked success, and with this manifest advantage, that while most of the tanks individually contained as much water as was found in the whole series of tanks in some aquaria, others were of such enormous dimensions that they were actually oceanic, when compared with the tiny table tanks in which a circulation (supplemented by aeration) was kept up. The first and greatest advantage of aeration proper over circulation was this, that whatever took place in any particular tank was confined to it, and could be watched and observed. So that if animals were hatched out or plants made their appearance, instead of the doubt as to what they were, or whence they came, it was at once known, because, instead of being all over the Aquarium, and scattered about in every tank, or probably killed by being carried by the system of circulation into a dark underground reservoir, they were confined to the one tank in which they made their appearance. To take a case in point, as an illustration. A cod-fish spawned in the Brighton Aquarium, the roe was seen floating on the top of the tank in which the creature was, and was identified at once. In the system of circulation, on the other hand, when a similar event happened, roe was found floating at the top of every tank in that Aquarium, and it was not, at first, evident to what particular fish it belonged. Another minor, but still practical, advantage was this—if, as sometimes happened, a glass was broken and a tank had to be emptied to enable the necessary repairs to be made, there was comparatively speaking, no difficulty with aeration, though there might be with circulation in an Aquarium of such gigantic dimensions.

Having generalised thus much, it might be well to point out a few of the principal gains to science, through the means of the Brighton Aquarium. George Ossian Sars, as Mr. Lee, F.L.S., F.G.S., had informed them, was the first naturalist to observe and record the fact, in 1865, that the roe of the cod-tribe, as well as that of the mackarel and other fish, was not deposited, as was believed, amongst sand and gravel at the bottom of the sea, but floated on the surface of the water during the whole period of its development. These observations had been proved correct, over and over again, in the Brighton Aquarium. The first recorded observations at the Brighton Aquarium were made in November and December, 1873, and January 1874, on the spawning of the cod, whiting, and whiting-pout. The floating of the roe was a most important fact, because it was a very strong and potent argument against a close time for deep sea fishing, and for laws interdicting deep sea trawling, and cut the ground from under the feet of those who would urge upon the legislature the necessity for a close time, and who affirmed that very great injury was done to ova by the trawl net. If, as had been proved, the roe of the *gadidæ* and of some other fishes floated, trawling could in no respect damage or destroy; moreover, as it had been found by observation, these fishes were spawning during several months in the year in one locality, it might reasonably be inferred that, like the herring, they were spawning all the year round on some portion of our coast, consequently the appointment of a uniform close time would simply be inoperative and impossible.

The opinion of Aristotle, that the time of incubation of the eggs of the octopus extended to a period of fifty days, had been completely confirmed. Eggs, too, of the cuttle and squid had also been hatched out in the Aquarium; events had also proved that an often expressed opinion of Mr. H. Lee was correct, that the octopus did not incubate her eggs in the same sense in which a fowl hatched her chickens, but that her constant attention was for the purpose of protecting them from injury and from vegetable and animal parasites. This Mr. Lee demonstrated by removing some of her eggs and succeeding in hatching them out away from the care of the mother.

He must at this point record another triumph of Mr. H. Lee's ingenuity. He had often found the eggs of dog-fish attached to Gorgonias by the parent, and hit upon the device of imitating the appearance of gorgonias by fixing birch-broom twigs to stones at the bottom of the tanks, and then had the very great satisfaction of seeing the female attach the eggs. This operation entirely set at rest two questions maintained even up to the week preceding the observation, viz.—first, that the eggs were fastened by "some inherent vitality in the tendrils," like those of the vine; or secondly, as Mr. F. Buckland supposed, that she fastened them with her mouth and nose. The time, too, which elapsed between the deposit of the eggs and the hatching out had been established, viz. six months; moreover, the fish hatched out in the Brighton Aquarium were alive by hundreds, and in a very flourishing condition.

It had been found, by Mr. Lee's observations on the eggs of the skate, that they differed essentially from those of the dog-fishes, in that they had a fibrous matter which issued from the body of the parent in a glutinous condition, and in this state attached itself to stones, shells, or other substances on which the parent might be lying, and was thus weighted down, instead of being attached by tendrils which were not glutinous when they issued. The arrangement of the glutinous fibres varied considerably in different species of the *Raiidæ*.

Though the pipefish and *hippocampi* had been very closely and carefully watched, the transference of the ova from the female to the pouch of the male, in which they were hatched, had not been at present observed. He knew it was Mr. H. Lee's opinion that this transference probably took place at night, because, though on several occasions a gravid female had been closely watched, the transference had taken place before the morning. A curious mistake made by Yarrell and others, repeated even in the first edition of the "Guide to the Brighton Aquarium," had been corrected in the third edition —viz., that the young fish, after leaving the pouch of the parent, repaired to it for safety on the approach of danger. He had also heard and read that if the young were shaken out of the pouch of the father and he were held in the water, they would swim back to the pouch. When once the young had left the pouch, they never returned to it; they swam to the surface, and (for he had watched them for hours) neither were able nor desired, apparently, to obtain the supposed protection within the body of their male parent; nay, up to the time of their extrusion, they were as tightly packed together as herrings in a barrel. These stories respecting their supposed habits were among the fables of fish lore handed down down from one book-maker to another, and which observation of the habits of the fish while in captivity alone could have refuted.

At one time the larval stages of the crab, lobster, and crayfish were thought to be separate and distinct forms of life, and were known by distinctive names. It had though, for some time, been known that two of the supposed distinct forms were merely the young of the crab and lobster, but only within the last few years was it proved, he believed by M. Coste, that what had been called *phyllosoma*, or glass crabs, were but the larvel state of the sea crayfish *Pœlinurus vulgaris*. These facts had been confirmed again and again, for at times the tanks in the Brighton Aquarium containing crabs, lobsters, or crayfish had been seen literally swarming with young crabs, lobsters, and crayfish respectively. Some members of this society would call to mind the circumstances that, at one of their microscopical evenings, Mr. H. Lee showed that Bell was right in asserting that the tail of the young lobster was spatulate, by exhibiting young lobsters with spatulate tails alive under the microscope, a fact respecting which Mr. J. K. Lord expressed his doubts some time ago in the pages of *Science Gossip*.

One of the greatest triumphs achieved in the Brighton Aquarium, in his opinion, had been the keeping alive, for five, and seven months respectively, a porpoise. Nowhere else would it be possible to keep such an animal alive for as many days. He believed he was right in saying it had been attempted in other places before the Brighton Aquarium was opened, but they failed, because there was nowhere else in the world a tank of such gigantic dimensions as tank No. 6, which was over 100 feet long 40 feet wide, and held the enormous number of 110,000 gallons of sea-water. He had heard some ignorant of the difficulties in this case grumble because porpoises would die; but they forgot it was no small matter to keep alive even for a week, to say nothing of months, an animal so swift-moving and so far-travelling as the porpoise. If any means could be devised of giving a captive porpoise a sea-bath in the open sea for a few days, then, he believed, they might succeed in keeping one alive for years.

He considered it no small triumph that, in the case of migratory fish, like the mackarel and herring, they had been, as it were, tamed, and shown to the public in shoals. He might safely affirm that, until the late Mr. J. K. Lord succeeded in keeping alive within the tanks his one pet mackarel and some herring, the feat had never been accomplished. Since then, in the Brighton Aquarium, shoals of these delicate and timid fish had been successfully exhibited to the public. This was the greater triumph, because it had been dogmatically asserted that such a thing could never be accomplished on account of the looseness and conformation of their scales. Those who had watched the mackarel knew how enormously they had increased in size; he might add that since they had been in the tank, more than two years, only one of their number had died; the same remark applied to the shoal of herring, while in the case of the shoal of red mullet, *not one* had up to that time died. He might incidentally mention that, in addition to the exhibition of shoals, not single specimens, alive, of many of our own common and familiar fish, illustrious foreign fish had also been exhibited in the Brighton Aquarium for the first time in England in captivity, and some creatures exhibited in other places had spawned; thus the English public had been made familiar with those strange representatives of the extinct trilobites, the king-crabs of America, the telescope fish of China, the pretty and elegant sterlets of Russia, the mud-fish of Gambia, the boar-fish, and the axolotls, which last named had twice spawned in the Aquarium. Very valuable additions to our knowledge of these rare, as well as of more common fish, had been made, which future writers on fish matters would do well to note, instead of copying the errors of their predecessors.

Among other interesting experiments that had been tried in the Brighton Aquarium, he might mention those on the bearing of the porpoise in water, while the taming of fish proved that so far from their shunning man, they might be taught to approach close to him, some being even so tame as to take their food direct from his hand. Then there was the fact, which anyone, who felt inclined to watch the behaviour of the flat fishes, like the sole and plaice, would soon observe—the rapidity with which they changed colour, and how closely they assimilated in colour to the nature of the bottom of the tanks on which they rested; this was so rapid and so imitative that they might with justice be called the chameleons of the deep.

As many were aware, he mentioned, at their last soirée but one, that the Brighton Aquarium had given a sponge new to science; it had also been proved, which was unknown before, that some sponges were annual in their growth, and died at the end of the year.

He considered, had the Brighton Aquarium done nothing else for science, it had set an example which every museum throughout the kingdom, not excepting the Brighton Museum, would do well to follow, by fitting up microscopes under which the minute anatomy of marine life had been made familiar to the public, while even the student of natural history had learnt much through the admirable slides and preparations of Mr. H. Lee. He hoped the day was not far distant when a part of the equipment and furniture of every museum would be the microscope, under which slides, illustrating the different departments of geology and natural history, would be shown to the public, who would by this means be educated to an appreciation of higher and better things. This naturally led to a point to which the Directors had, he thought, hardly given sufficient attention—the formation of a marine museum. It was true they had very wisely commenced the nucleus with the exhibition of choice and rare specimens, but they might add considerably to the interest of the Brighton Aquarium by making this a far more important feature than it was at present. He could speak feelingly in Brighton, and especially in that Institution, "The Free Library and Museum," under his charge, of the liberality with which the Directors had contributed duplicates. Upstairs, anyone could see "Presented by the Directors of the Brighton Aquarium," upon many of the specimens in the cases, and he was in possession of the information that the same liberalty had been extended to other museums in the country, which had been enriched in their natural history departments by the presentation of duplicate specimens and preparations.

Experience had shown that fish caught with a hook were much more likely to live than those captured in a net, the wound caused by the hook in the majority of cases quickly healed, and the animal seemed none the worse; but the damage inflicted on the scales of those captured in a net generally proved fatal, and taught the very important lesson that removing or rubbing the scales of a living fish was about as safe an experiment as scarifying the cuticle of a human being with a currycomb; in fact, it would be safer to currycomb a man than to brush and scrape the scales of a fish. In moving, too, some fish, either from the sea or from one tank to another, they must be lifted in water and not in air.

Few outside the walls of the Brighton Aquarium realised one-tithe part of the difficulties inherent in such a large Institution, especially in the way of regulating the temperature, to say nothing of taming and accustoming wild creatures to captivity and confinement. Some would think all that was necessary was to fill a tank with sea water, catch the fish, put them in it and feed them; little imagining that each of these processes involved trouble, and, at times, failure after failure before success could be obtained. It was no easy matter to regulate temperature situated as the Aquarium was; then the influx of visitors at times, raised the temperature within the building considerably above that of the water in the tanks, when, as a natural consequence, crack went a pane of glass, the water must be allowed to "run off," and the labour of weeks or months was lost or endangered. Evaporation from such large surfaces carried off no inconsiderable portion of water, which must not only be replenished, but great judgment was necessary to preserve the specific gravity of the water, or mischief would accrue to the fish. Again, the pumping in of fresh sea water caused a turbidity and milkiness, which must be removed, for the public was not satisfied unless the water was as clear as crystal. To accomplish this, a plan was adopted with very marked success, which originated, he believed, with Mr. H. Lee. Some one, he rather thought Dr Brehm, mentioned that the mollusca were great agents in clearing sea water, and the late Mr Lord, just before the opening of the Brighton Aquarium, tried mussels, but the difficulty was to know whether any of them had died, and if so, a greater difficulty was to pick out the defunct ones. Mr. Lee suggested to him that the mussels should be suspended in nets, but still there was a difficulty. At last it struck Mr. Lee, when he took charge, to try oysters instead of mussels, and with a very marked success. Oysters were still employed in the Brighton Aquarium for the purpose of clearing the water, and this would explain the reason why that mollusk might be seen at the bottom of each marine tank. The capability of clearing the water by the oyster was not only doubted, but denied, by some. This capability had been demonstrated in his own presence by seeing sea water with and without the mollusk; that in which the oysters had been placed was clear, that without them was turbid. Any member of the society could easily, at any time, prove the truth of this experiment for himself, and see with his own eyes how the oyster cleared the water.

Another difficulty was to find out what was the kind of food which different fish would take, and then an equal, if not greater, difficulty, to induce the fish to eat, for not until then could it be safely affirmed there was a possibility of getting the fish to live. It had happened, over and over again, that even when the food was well known from experience, and fish of the same kind were thriving on that kind of food, new comers could not be induced to take the same, or any kind, of food. By observing the way in which different kinds of fish always took their food—some as soon as it was dropped into the water, others rising at it, and others taking it while it was passing by them downwards, others only when it had fallen to the bottom, some darting rapidly at their food, others quietly seizing it—a very valuable series of hints for fishermen had been acquired. Fallacies, too, respecting the Salmonidæ and their habits had been exploded; in fact, looking to the advantages derived by science, as many fallacies had been exploded as new facts acquired.

There was one matter relating to fish to which he hoped the Directors of the Brighton Aquarium would direct their serious attention, viz., popularizing, as articles of food, sundry fish which seldom found their way to table, because, from some unknown cause, or false prejudice, they were tabooed. There was the pilchard, seldom found in Brighton or London markets, except at times under the name of so-called herrings, and yet Cornwall sent millions of them to the markets of southern Europe; the ray family and the dog fishes, which were not generally known as articles of food, might have their name and fame spread abroad and prove to be worthy of finding their way to the dinner table, if experiments, such as one of which he had very pleasant recollections, were tried and shown to be successful. He alluded to that famous fish dinner at the Aquarium, in January of that year, when the hitherto tabooed fish, the conger, was served up in sixteen different ways, and pronounced by those who knew its merits, and by those who, up to that time, knew them not—a fine fish. If they could help them to obtain good supplies, and cheap ones, of fish, as articles of food, they would become national benefactors.

There was a fine field open to them, and if they failed of success, yet they would secure the next best thing, the credit of having tried to obtain it.

He might incidentally allude to the very absurd stories which had been circulated by some, from what motives he did not trouble himself to enquire, respecting the unhealthiness and mortality of the fish in the Brighton Aquarium, as compared with those in the Crystal Palace Aquarium. He had no intention of drawing invidious comparisons, nor of attempting to prop up one institution by decrying another. He held that each should stand or fall on its own merits; but this, as he should show, he could fearlessly assert, that it would be difficult to point out any place, where the fish were more healthy, and the mortality was less, than in the tanks of the Brighton Aquarium.

The tanks in the Brighton Aquarium were of such huge dimensions that two or three fish in one of them appeared as nothing, and some people had coolly asserted that there were very few fish in the Aquarium; now, excluding anemones, which might be counted by the thousand, crabs, lobsters, prawns, shrimps, oysters, and all but fish proper, belonging to the class *pisces*, it would appear that the tanks of the Brighton Aquarium contained nearly ten thousand fish. To show that he was not in the least exaggerating, he might mention a few of the numbers of particular fish: thus, he found about a 100 bass, the same number of bream, 300 carp, 50 chub, 50 cod, some of them of enormous size, the same number of congers (one about 50lbs. weight), 200 dog fish (in addition to about 500 hatched on the premises, and rapidly increasing in size), about 500 flat fish, including soles, plaice, &c., 100 gurnards, 40 gray mullett, 100 perch and pike, nearly 40 pipe-fish, the same number of hippocampi, 40 roach, 17 salmon (seven hatched last year), besides about 1,500 young char, salmon, and trout, all in a thriving condition, and hatched out that year. Half a dozen skate (one 5ft. across), angel fish and rays by the dozen, 1,000 sticklebacks, 150 whiting and whiting pouts, 200 wrasse, together with herrings, mackarel, tench, and a host beside; and when he learned by inquiring, at the end of last week, that *not one fish* had that week died, only *one* the week before, and *none* the week before that, and that, on an average, one or two a week had been the rule for some time past, he concluded that, first, the assertion, that there were a few fish only, would not hold good; and, secondly, that 50 or even 100 in 10,000 in a year was a low rate of mortality, not yet attained among human beings, and proved how marvellously healthy fish were, when compared with man. These facts and figures spoke for themselves, and conclusively upset the fables mischievously circulated respecting the reputed paucity and mortality of the fish in the Brighton Aquarium, when compared with those in other and minor aquaria. There were many other points of interest to the scientific student, to which he had not had time to allude, but he knew other members would be glad to hear that the observations of Henry Lee would soon be given to the world in a collected form. The public must not expect that fresh fruits or observations would continue to come before them in such abundance as during the past year or two, because the scientific truths, which the commencement of the Aquarium's existence had tunity of establishing a museum on a good scale; and, for his own part, he sincerely trusted that opportunity would be embraced.

The PRESIDENT invited discussion, especially calling attention to the presence of Mr. Henry Lee, F.L.S., F.G.S., President of the Croydon Microscopical Society, and the Naturalist attached to the Brighton Aquarium.

Mr. HENRY LEE said the first feeling that arose in his mind, while listening to the able paper which Mr. Wonfor had just read, was one of gratitude and gratification that he had brought forward the subject; for he confessed that, when hearing and reading certain statements that were brought under his notice, he sometimes began to wonder whether the Brighton Aquarium was a failure and a sham, the Directors idiots, the Manager a charlatan, and the Naturalists ignoramuses. But, when he found how the institution was appreciated by Mr. Wonfor, and his fellow members of the Brighton and Sussex Natural History Society; as also, when he marked the approbation it received from the London and Provincial Press generally, he rested—certainly not entirely satisfied—but at all events encouraged by what had been done. Helped on by the Board of Directors, he hoped in the future to continue and extend the labours of the past. Whatever credit Mr. Wonfor had been kind enough to bestow upon him, there was an act of justice due to a gentleman who was now absent. Owing to the bad work of the contractors, the architect's original designs, for the aeration and circulation of the water in the tanks, were not carried out when the building was completed. It was at first intended that the system of aeration should be the same as that adopted at the Crystal Palace; but, in consequence of the construction of the reservoirs, this was found to be impossible. When the Aquarium was opened, there was neither aeration nor circulation; and, in order to sustain the life of the fish, he oxygenated the water by exposing it to the full sunlight and promoting the excessive growth of weed and of marine algæ; and, notwithstanding it was thought by some that, in so doing, he was raising a Frankenstein, which, in time, he would be unable to quell, he succeeded, by this means, in keeping large numbers of fish alive until the new and present system could be adopted. The credit of the system of aeration to which Mr. Wonfor had alluded, was due to Mr. Evans, a former member of the Board of Directors, who had devised the where the weather was warmer. A brief reference to experiments, showing the effect of heat and cold upon the young oyster, was followed by an acknowledgment of many kind efforts to assist the Aquarium, and by an expression of gratitude, on behalf of the official staff of the institution, to Mr. Wonfor for preparing the paper, and to the members of the Press, for assistance kindly rendered on all occasions.

Mr. F. C. **Dennet** expressed his delight at what he had heard; and made a few observations with reference to the Boulogne Aquarium; to the difficulties which had been experienced there; and to the manner in which similar difficulties had been overcome at Brighton, by the wisdom of such men as Mr. Lee, Mr. Buckland, and others.

Mr. **Haselwood** remarked that Mr. Wonfor had shown them how, when they visited the Aquarium, they might open their eyes, see and understand. He was only afraid that, as there was a possibility of getting things too cheaply, there was also a probability that they had got the fruits of fifteen months' study and attention too easily. Mr. Lee's kindness in furnishing live specimens for the microscopes, on one very memorable occasion in the annals of the society, had been very highly appreciated; and he ventured to hope that they would be again similarly favoured by that gentleman.

Mr. **Lee** said it was sometimes difficult to obtain certain specimens from certain tanks, as a sudden disturbance of the water might cause the death of timid fishes, such as the herring and mackarel; but he assured the members that, whenever specimens of special interest could be obtained, he, and the Directors of the institution, would be ready and willing to present them for examination. He might also take occasion to confirm what had been said that it must not be expected that fresh fruits of observations would continue to come before them in such abundance as during the last year or two, because the scientific truths, which the commencement of the Aquarium's existence had evolved, would be re-affirmed again and again. Six specimens of the proteus, a type of amphibious reptile, closely allied to the mudfish, and brought from the Adelsberg caves, had been deposited in the Aquarium during the week.

After some further conversation, in which the Rev. J. H. Cross, Mr. O. Fox. Mr. Dennet, and Mr. Haselwood took part,

Mr. Wonfor briefly acknowledged the vote of thanks that had been passed to him; and, in turn, proposed a hearty vote of thanks to the Directors of the Aquarium for facilities they had afforded him in obtaining information, and for the way in which they had helped the society on various occasions.

Mr. Haselwood seconded.

The Hon. Howe Browne, in acknowledging the vote, stated that the Directors would continue to be, as they had at all times been, willing to afford every assistance to the society in providing scientific entertainment, or the means of scientific investigation.

May 27th.

MICROSCOPICAL MEETING.—GENERAL EVENING.

The announced paper was on "Vegetable textile fibres, microscopically considered," by Mr. C. F. Dennet. Mr. J. C. Haselwood, Vice-President, having taken the chair, said he believed Mr Dennet could not fulfil his engagement, but Mr. Wonfor would make an explanation on his behalf, and would, moreover, provide some objects of interest.

Mr. T. W. Wonfor said he had received a note from Mr. Dennet, to say that he was "knocked up and unable to leave his room," and, on going to see him, he found he really was seriously ill. Having to go to London the day before, on business in connection with the Museum, he made his way round to their good friend, Mr. Curties, of High Holborn, and in ten minutes he packed up some objects which he thought would interest them. Among them were some transparent mountings, made up out of butterfly scales and diatoms. These objects, instead of being opaque, were transparent. Mr. Curties also found him one of the red deer ticks, which, they would remember, had wings; and he promised them some more specimens of the other species. In addition to these, he enclosed some mountings by a mounter new to England, namely, Rödig, of Hamburg, who gained a medal at the Vienna Exhibition of 1873; certainly some of them were very clean preparations. A most remarkable slide was some diatoms from Java, one of Müller's mountings; they were like a number of vertebrae. Indeed, there were some very interesting objects, especially good were those showing the scales of plants, a rhododendron among them being well worthy of attention. He would like to know if they desired him to keep his promise and give a paper on fur, wool, and silk, that day month.—The Chairman said that under the circumstances in which they were placed by Mr. Dennett's illness, he thought it would be desirable.

Three pen and ink sketches, illustrative of the Society's last field excursion, were presented by the Rev. J. H. Cross.

The meeting then resolved itself into a Conversazione, when the objects mentioned, and others, were exhibited by Messrs. J. C. Haselwood, T. W. Wonfor, F. E. Sawyer, W. Puttick, T. Glaisyer, and R. Glaisyer.

JUNE 10th.

ORDINARY MEETING.—MR. BENJAMIN LOMAX ON "THE MINOR DISEASES OF PLANTS."

The subject was one which was not even referred to in the standard works on Vegetable Physiology, and concerning which he could give no information that was not supplied from his own limited powers and opportunities of observations. We were accustomed to think of plants in one of two conditions—that of rude health or that of mortal disease. If a plant presented its normal appearance, performed its functions properly, and attained its average size, it was a healthy organism. If it was monstrous in form, stunted in growth, or irregular in the performance of its functions, it was a diseased plant and would die. So we summed the matter up, except in those few cases where science had enabled us to fight successfully against rust or blight, and to restore to full health an organism that, but for the intervention of human agency, must have perished. But surely this was a very limited view to take of the diseases incident to vegetable life. Medical friends would find both their duties and incomes strangely curtailed if their practice were limited to fatal maladies. Although Nature generally worked her own cure in certain cases, we were glad to shorten her work by the intervention of medical aid, and the physicians considered the symptoms as well worth their study. It was so with the vegetable kingdom. Among the thousands of plants that lived out their allotted time and ripened, and left healthy seed behind them, few escaped minor complaints, and the study of their symptoms, their causes, and the methods of cure which Nature adopted, could not fail to be of interest to Naturalists. The more obvious cases of self-cure were those which belonged to what might be called the surgical department—cutting and wounding—in the cure of which there was both a likeness and a difference as regards the animal economy.

When Master Tommy cuts his finger, the blood flows. Here they had the very means of death presented, for it was from loss of blood that men died in battle. But, practically, the injury was trivial—the bleeding stopped from the contraction of the tissues, the surface blood coagulated and formed a plaster, and in a few days all trace of the wound was gone. In like manner, when a branch of a shrub was taken off, whether by the gardener's knife, the browsing of animals, or by a gust of wind, the very state of things that Nature had by all possible means guarded against was now set up. The delicate inner portions were exposed to the light, while the sap, which should have flowed in closed channels, was now suffered to pass freely into the air; and, theoretically, the plant ought to die, as in fact it would when the injury was extensive, for not only must exhaustion follow the loss of sap, but the atmosphere passing into the vessels would cause it to become thick and incapable of flowing. But this very tendency to inspissation saves the plant. The surface sap coagulated so rapidly as at once to exclude the atmosphere and stop the bleeding, the surface-wood cells hardened, and the inner layer of what was once sap assumed the form of cambium. Next year a layer of bark was formed over the wound, and all that remained was an outward change of form. It must not, however, be forgotten that in all this there was no interference of what was called "vitality." The flow of sap was due to *dialysis*, the coagulation to evaporation, and there was no appearance of anything like muscular contraction.

From this point even outward resemblance between animal and vegetable ceased. The animal cure was a restoration—a replace-ment; if we cut a notch in our flesh the immediate curative process was followed by a formation of new flesh which, under favourable circumstances, continued till the notch had entirely disappeared. We could not, it was true, in our own complicated organism, grow a new leg or arm; but the process, as far as it went, was towards such restoration, and in a lower sphere of animal life, we did actually find snails reproducing their eyes, crustacea their claws, lizards their tails, and Holuthuriæ their simple digestive apparatus. In the vegetable world, on the other hand, the notch, or broken limb, retained its new shape, and simply covered the disfigurement with bark.

The efforts which Nature made to repair the functional loss shewed this difference even more decisively. A plant or tree must, for its necessary sustenance, spread a certain area of leaf surface to the atmosphere—and when a branch was removed the loss must be repaired, or the tree would die. How was the deficiency to be made good? A plant stood much in the position of a gambler who had so many cards or counters to dispose of, and who could withhold them, or apply them in different manners, but could not play them twice. Every flowering plant was compelled by the mysterious law of its nature to develop its buds in a spiral, according to an unchanging arrangement. Of these buds it might make leaves, tendrils, thorns, branches, stamens, carpels, petals, or bracts, as occasion required. It might develop a bud almost *ad infinitum*, might change stamens into petals, or spines into tendrils, or might allow it to remain a bud, but it could not play its card twice—a bud once destroyed could never be replaced. Hence, to repair the loss of the amputated branch, another bud which would otherwise have remained undeveloped must take the duty upon itself, and supply the functions of its deceased brother. It was of this peculiarity that gardeners took advantage, when, by pruning or nipping off buds, they compelled trees to assume a different shape, or to push forth lower branches at the expense of the upper ones. Still, there was, perhaps, no evidence of "vitality," for we could regard the diversion of the sap into the only available channel as a mere mechanical result of the general law of cell development. But, in the *selection* of the bud which was to sprout, a very marked instance of what might be called "plant instinct" was shown. Every plant was a carefully balanced fabric, assuming one general direction, whether upright or recumbent, and bounded by one well defined curve. In an upright shrub the removal of a branch to the left gave a tendency to lean to the right. As the original branch could not be replaced, another on that side must sprout. Owing to the rigid law of general outline, it was probable that none could be found which was licensed to carry the same weight, but by a judicious use of two or three, their respective leverage being taken into account, and some forbearance on the part of the buds on the other side, the balance was generally restored without injury to the outline. Often the main stem itself bent over somewhat to favour this equilibrium, but in every case he who set his skill against that of a tree, and tried to force it out of its time-honoured habits, would find it an opponent worthy of his steel.

Another form of disease was that which is caused by injudicious or improper food. A plant which had injudiciously swallowed a dose of ink or vermillion would at times get rid of it by a process of desquamation very curious to witness. Those who had transplanted a cabbage in very dry weather had seen a little piece of self-cure. A large quantity of water was usually given in such cases, and a few large leaves were plastered to the ground. These leaves were living sacrifices. Times had changed with the unhappy vegetable—many of its root fibres had remained behind in its once happy home, and it had no longer the power to nourish the large number of leaves that looked to it for food. These large leaves comprehended the necessity, and acted the part of martyrs, and by their death a sufficient supply of nourishment was left to meet the wants of the next pair. In this slow death, every circumstance was puzzling. The strange yellow colour which leaves of every shade assumed, creeping from the point to the stalk, told the gradual process of the change, and reminded one of mortification in the animal frame. A large white dead nettle on the Rottingdean road, which had produced a continual succession of flowers for weeks past, had lately found it necessary to perform an amputation on its own person. He thought, but was not sure, that some insect damaged the part since affected, a spreading leaf half way up the great square stem. The tapering point first showed the yellow tinge, which soon crept along the margin and gradually covered the whole leaf. It reached the main stem and the leaf with its petiole fell off. He was inclined to think, after much observation, that the leaf and petiole were not all that were cast aside, but that the injury extended to the root.

He was forced to the conclusion that the theory is correct which assumed that every separate bud was connected by a distinct thread with the root, and that the axis of the plant was really a mere bundle of separate stalks surrounded by a common epidermis. The order to which this dead nettle belonged was an instance in support of this view. The leaves of all labiate plants were opposite, and each leaf was exactly above that beneath it on the same side. This was, in fact, a quarternary arrangement, the alternate internodes being suppressed. According to the theory he had adopted, the stem consisted of a concentric series of squares, the four bud threads occupying the corners; and the square stem which was universal in the labiatæ, and which was preserved even in the arrangement of the fruit, was thus fairly accounted for. That closely allied order, the Scrophularineæ, had not the same arrangement of leaves or fruit, and the theory was carried out here by the stem not being square. Just as in our own species Nature frequently preserved life at the expense of one faculty, so we found continually plants which were content to pass an imperfect existence, at the expense of some one of their natural functions. The garden rose or pink, given to luxurious living, parts with the power of propagating his species, and converted his stamens into petals. The wheat or grape vine infested by parasitic fungi or insects, lived on till the time of natural decay, but bore no fruit, and this kind of compromise went on throughout the vegetable kingdom. When the aphis infested our rose bush, or the blight our cauliflower, the plant did not generally die, though for *our* purpose it might be useless. The flower shed its buds before they burst into bloom, parted with those organs which were now no longer necessary, as the peduncle to support the flower and the bracts to shelter it, and reduced its vital expenditure as much as possible, to preserve its mere life through the winter. The cauliflower with blight at its heart, rejected not only the infected leaves, but those surrounding it, all which must ultimately share the same destruction, and, abandoning the acquired habits of many generations, developed anew the long suppressed internodes, and mounted upwards in the form of its ancestor, the common sea cabbage of our cliffs, with the recovered the shock its system had suffered. He believed the field of research he had indicated was a wide and an interesting one, but if it should not prove so, the necessity which it would impose on its votaries of watching individual plant-lives with care and accuracy would at least increase their botanical knowledge, however great it might previously have been, and would excuse his laying before them so superficial a paper.

The President, (Mr. Alderman Cox) proposed a vote of thanks to Mr. Lomax for his interesting paper, and enquired whether he could assign any reason why, when a new vine shoot was removed, no sap flowed, whereas, if a previous year's shoot were removed, the sap flowed copiously ?

Mr. **Lomax** replied that such a question revived the old difference as to whether sap really did flow. He thought that a copious discharge of sap was more often met with when the tree produced a succulent fruit than when otherwise.

Mr. **Wonfor** commented upon the mysterious fact that, whilst a plant might live, ordinarily, only fifty years, cuttings made from it, and planted, also lived the full alloted time, quite outliving the parent stock; so that thousands of cuttings might now be alive, the parents of which died years ago.

Previous to the reading of the paper, Mr. F. E. **Sawyer** briefly drew attention to some solar halos which he had recently witnessed, and illustrated his observations by diagrams.

JUNE 24th.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON "HAIR, WOOL, FUR, AND SILK, MICROSCOPICALLY CONSIDERED."

One of the first objects the possessor of a microscope subjected to scrutiny was a human hair; and scores of times, after exhibiting to some non-microscopical friend some very choice objects, the question had been asked, "But how does a hair look under the microscope ?" and invariably the querist was disappointed when a hair was exhibited at his or her request.

The popular idea was that a human hair was a hollow cylinder, that its colour was owing to the presence of a fluid within the cylinder, and that it grew with roots much in the same way as a tree. That a hair originated in a bulbous root contained in a depression in the skin was very certain, but there the analogy between it and a tree ended. A tree increased by a prolongation of its stem, through an addition to its cells from the apex, whereas a hair lengthened by an addition of cells to the basal portion, which pushed the rest of the hair forward.

Carefully examined under the microscope, a human hair consisted of three parts, the *cuticle*, the *cortical substance*, and the *medullary substance*. The cuticle consisted of epithelial cells, lying over each other like tiles, from one end of the hair to the other. The ends of the scales stood out from the surface and gave its outer circumference a jagged appearance. These scales caused the hair to appear as if there were fine irregular lines crossing its surface. These scales were a very important part in the economy of some hairs, because they accounted for the ease with which the wool or hair of some animals felted. The *cortical substance*, which formed the principal, and in some cases the whole, of the shaft, consisted of closely packed cells in rows, and lying nearly parallel to the axis of the hair, thus giving to some hairs the appearance as if striped lengthwise. These cells were so closely united that only under the action of concentrated sulphuric acid could they be separated into spindle-shaped cells.

It was in the cortical substance that the colouring matter, sometimes diffused through the mass, but generally scattered in pigment cells, was found. The cortical substance also contained a number of cavities filled with air. These were most patent in dry hair, or that from the head of adults or the aged. The medullary substance generally occupied the centre, when present, because in woolly hair and that from a new-born child it was absent, also in some examples, of blonde hair. Some considered the medullary substance cellular, others thought it was not, but the general opinion inclined to the cellular. It had also been thought to contain the pigment, but the supposed pigment granules were minute air-bubbles. The medullary substance was best made out in white hair.

What had been said respecting human hair held good generally in mammalian hair. We found the same three layers, differing, though, in such a degree that the animal from which the hair came could be recognized under the microscope. In most animals the *cuticle* had larger cells, relatively, than in man; this gave it a toothed and jagged appearance, well-seen in wool from the sheep. In some cases, as in the mouse, but more especially in the bat, the cuticular cells stood out so much as to give the hair a feathered appearance. In some animals the great bulk of the hair was formed of the medullary substance, the cuticle being only a very thin layer.

In comparing the hairs of animals with human hair great care was necessary, because dog's hair, when brown, was often very similar to human. Among the monkeys, some very closely resembled man's hair, but the air cells were larger and less crowded. If a collection of hairs from the different orders of mammals were taken, it would be found that in each order there was great similarity, but sufficient diversity to enable the microscopist to predicate the animal from which it had been taken. In some animals two sorts of hair were found, one long, strong, and more or less straight, the other long, curly and twisted—to one the name of fur was given, and to the other the term wool had been applied. Some animals had only wool, which differed from hair in that the cuticular cells or scales were looser than in hair. This gave to wool its value, its property of *felting*, *i.e.*, of being so interlaced and entangled by the combined action of heat, pressure, moisture, and motion, as to form a cloth-like substance. This property was seen best in the wool of the sheep or that from the rabbit, which latter when mingled with sheep's wool, formed the best kind of felt for hats. The same property which caused wool to *felt* caused any woollen material to become closer and thicker by shrinking, either after exposure to moisture or washing.

In comparing wool from different kinds of sheep, the greater the number of cuticular cells to the inch the greater its felting property, hence its greater commercial value. Thus. Leicester give 1,850 to the inch, Southdown 2,080, Merino 2,400, and Saxon wool 2,720. This same felting property was found in the wool from some goats, and differed essentially from goats' hair, this was the case with a very fine kind of goat wool called *Mohair*.

If, in the manufacture of any texible fabric, any hair or wool of an inferior character had been employed the microscope readily revealed the fact, so that so-called alpaca lustres, supposed to be made of the hair of the American camels, the alpacas, were shown at times to be made out of goat's hair. People bought woollen fabrics, or so-called woollen fabrics, and wondered why they *cockled*. The simple explanation was that some vegetable fibre, of different hygrometic properties from wool, had been mixed with wool in the manufacture. The microscope soon revealed both the nature of the wool and the presence of the woody fibre. The same might be said of the cheap furs with names not belonging to them. *Genuine sealskin* turned out to be rabbit or monkey. The same might be said of other and equally expensive furs.

He must next say a few words about silk, the production of caterpillars of different kinds, and emitted from special organs called the spinning apparatus. Some caterpillars spun but little, and then only to attach themselves during rest, or moulting, to their food plant; others spun a small quantity to fix them to a twig when about to change into the chrysalis, but others manufactured a considerable quantity, and with it constructed the silken cocoon, in which the caterpillar changed to a chrysalis. Although many caterpillars went through this process, the cocoons of only a few were utilised in spinning and weaving the substance called silk. The fibres of which it was composed were cylindrical or somewhat flattened, without markings of any kind, and solid. The silk cylinders were coated with a gum-like varnish, while an analysis showed that silk consisted of fibroine, gelatine, albumen, wax, yellow colouring matter, resinous and fatty matter, the colouring matter being absent in white silk. It would be out of place to enter into the different kinds of silk used in manufacture, but all possessed similar absence of markings, hence, the readiness with which the presence or absence of an adulteration in a textile fabric could be detected. Japanese silk, or rather so-called, largely consisted of jute, and a specimen of a said-to-be pure silk fabric, which, owing to unequal contraction when exposed to moisture, was suspected to be impure, turned out when examined under the microscope, to be composed of one-half vegetable fibre having markings.

All the manuals gave information how to mount hairs, &c., but the structure of a human hair could be made out by making a section with a razor. After shaving, if the skin was scraped and the portions of hair found on a razor were washed off with ether, and placed in a drop of turpentine on a glass slide, sections of human hair might be readily got. These might be mounted in balsam. A section of the hair of the pachydermata, especially of the elephant, presented the appearance of several hairs welded together. Next to the bat tribe, the most extraordinary hair was that of the Platypus of Australia.

Mr. **Wonfor** stated, in reply to Mr. H. Saunders, he never found flint in the substance of the hair. On hair of the elephant or pig, or other mammal exposed a good deal, fine particles of dust might be found, but they did not belong to the substance. In reminding the meeting that hair, horn, teeth, and claws lasted longer than the human or animal frame, he also stated that he had obtained some hair off an Egyptian mummy, and it was perfectly red. The reason of this colour he could not at first conceive, the Egyptians not being represented to have been a red-haired race, but subsequently he came to the conclusion, from inquiry and examination made, that the redness had resulted from the substance which had been used to ensure its preservation.

In reference to what had been said with regard to the power of endurance of the teeth, the **President** (Mr. Alderman Cox), humorously hinted that the assertion would doubtless be qualified by the majority present from their own experience.

A conversation, of a very entertaining character, was maintained for some time by Mr. C. F. Dennet and Mr. W. Saunders; and afterwards specimens and sections of hair from various animals, and vegetable fibres were exhibited under microscopes by Mr. Haselwood, Mr. Wonfor, Mr. T. Glaisyer, Mr. R. Glaisyer, and Mr. Puttick.

JUNE 29th.

ANNUAL EXCURSION.

The twenty-first annual excursion of the society was to Battle Abbey and the Sub-Wealden Boring at Netherfield. The majority of the party, which numbered in all about fifty persons, left Brighton by the 7.55 train for St. Leonards; where carriages were waiting to convey them to Battle, the object being to pay a visit to the fine old Abbey, the Duke of Cleveland, the present owner, having kindly extended the privilege to the Society of allowing its members and their friends to enter an hour before the general public were admitted.

Acting as guide to the party, Mr Wonfor (assisted by one of the gardeners of the Duke) took them into almost every nook and corner, and fully explained the chief features of the interesting pile.

Battle Abbey is most closely connected with our national history, having been erected by William the Conqueror, in commemoration of the victory he gained over Harold at the Battle of Hastings, which decided the fate of the kingdom and completely changed the whole of its civil and political institutions. The Abbey is erected on the site of the battle, which gives the name to the town, and in the grounds still grows an oak, planted on the very spot where Harold fell. In the oldest documents among the muniments, the Abbey is called "The Monastery of St. Martin of Bataille;" but the orthography of the town has undergone many changes. It was first Battaille, then Bataile, Batayle, Battayl, Battele, Battell, Battel, and now Battle. What the name of the place was previously to the Battle of Hastings is unknown; it is uncertain whether it bore any peculiar appellation, further than that it formed part of the Hundred of Hailesalted. The privileges enjoyed by the Abbot were very great, even to having conferred upon him the Royal power of pardoning any condemned thief whom he should pass or meet going to execution. The Conquerer intended to have endowed the Monastery with sufficient maintenance for 140 monks, but the building was not completed at his death, and it does not appear that more than 60 monks were ever on the foundation.

The once sacred edifice is, as a matter of course, nearly demolished, but much remains to give an idea of its former magnificence. The gateway, which faces the principal street of the town, is one of the finest in the kingdom. It is in reality a square tower, its height being half as high again as its width, with an octagon turret at each angle. The basement is divided into a double avenue by clustered columns, the roof being supported by groined arches, with rooms, two storeys high, over. For a monastery, the porch had the extraordinary appendage of a portcullis, and in the grounds are still standing the ruins of a guard-room, showing that the Abbey was, at one time, a place of great importance. The present Abbey shows many specimens of the styles of architecture in fashion in by-gone ages.

After exploring the vaults of the old Abbey, in some of which the botanists of the party found seedling hart's-tongue ferns in great abundance, the interior of the inhabited portion of the building was visited. The principal entrance is through a modern-built Gothic archway, and from the vestibule the great hall is entered by a pointed arch doorway. This is a very imposing room, and was originally the Hall of Justice. Its height is equal to its length, namely, 57 feet; it is 31 feet wide; and is lighted on one side with a window of seven lights reaching nearly to the top of the gable, three large windows being near the entrance. Around the walls, and high up near the roof, are hung complete suits of armour, banners, antlers, and other symbols of war and the chase. Between the wainscoting of the dais (on which there is still the State chair) and the great south window formerly hung the enormous picture of the Battle of Hastings—17 feet high and 35 feet long—which was offered, on loan, not long since to the Corporation of Brighton. The armour, it was said, included a suit of Guy, Earl of Warwick. The tapestry alone is worth a visit; and the library and pictures are very interesting. The vaulted drawing room attracted considerable attention. This room still retains its original form. It is believed to be the "locutorium," a room in which the monks were allowed to have interviews with their friends; but its arrangement is considerably altered. The Purbeck marble columns, Caen stone ribs, and vaulted ceiling of local stone are painted white and picked out with gold; the spandrils of the arches forming the sides being filled in with tapestry and mirrors.

On leaving the Abbey, the party adjourned to the Abbey Hotel, opposite the gate, where they were met by Mr. Henry Willett, who expressed his regret at not being able to offer them the same hospitality as on the occasion of the Society visiting Findon, some few years since. There he entertained them in his own house, and could do as he liked, but here he was only a visitor, like themselves. Still, he bid them welcome; and hoped they would partake of whatever the Hotel afforded, whilst he went on to prepare for their arrival at Netherfield.

An excellent cold luncheon was spread, and ample justice having been done it, the carriages were re-entered and a start made for the Sub-Wealden Explorations, which were reached about two o'clock. Netherfield is about seven or eight miles from Hastings, Battle being about mid-way between Hastings and the "Borings," as they are called; and the visit to these proved the most interesting part of the day's proceedings. As its name implies, Netherfield itself lies low; but, after quitting the high-road, the party went down, down, down, through "tangled brake and briar," till the engine-house of "the borings" was reached.

A core having been brought up early that morning, the works were again in full operation; and, as it was found necessary to lengthen the boring rod whilst there, the whole process was easily understood; Mr Thornton (the engineer in charge) and Mr. Henry Willett explaining in the most lucid manner how the auger bored its way through the earth and brought to the surface the core which it had cut.

The work is being performed by the Diamond Boring Company. As a matter of course, the boring is accomplished by the aid of steam, the driving power being a common portable engine. The boring machinery is of a simple but very ingenious character; in fact, the whole space occupied is only a few feet square. The depth of the bore was 1,267 feet. The auger is an iron cylinder of the diameter of the hole to be bored, held in position by two substantial iron uprights and two cross-beams, through which the auger (fixed to hollow rods) passes; the rotary motion being given by means of wheels and a driving band, as seen in ordinary machinery. To the end of the auger is screwed what is technically termed a "crown," but which might be more appropriately called a "coronet." It consists of a steel ring, of about 4 inches in width and half an inch thick; on the outer rim of which is set, in slight protuberances, half-a-dozen real rough diamonds, a similiar number being fixed in the inner rim; all set in much the same manner as the diamonds used by glaziers. Other diamonds are set in the sides of the crown; but these act only when those in the rim get damaged, their function being not to bore, but to prevent the setting of those which perform the cutting from being worn down by friction. The diamonds, weighing about two carats each, are of the value of 24s per carat; consequently, a "crown" is worth about £40; and the diamonds will bore to a depth of 500 feet before requiring to be re-set. They are set at a slight angle, and, as they rotate, those on the outer rim cut the hole, whilst those on the inner rim form the core; the strata through which they pass rising in a column inside the auger. The top of the auger has a diminishing socket; that is, it is dome-shaped, into the apex of which are screwed the boring-rods. These are in lengths of 3 feet each; and, as the auger descends, so the boring rod is increased in length, by an additional piece being screwed on. No mechanical pressure is upon the auger, the engine being required to merely give it the rotary motion, leaving the weight of the auger and rods to exercise the pressure necessary for boring. And this is very slight—about 30lbs. only,—but, as the auger and rods naturally increase in weight as the former goes deeper, and the latter are added to in number,—at the time of the visit the weight was between three and four tons,—the 30lb. pressure is obtained by counter weights, a balance-beam supporting the rods at one end, and taking the weights at the other. The crown of the auger is kept cool by water being pumped to it, the water returning to the surface after performing the double duty of cooling the crown and rinsing away the debris; its return being effected by being forced up the inside of the rods by the core rising in the auger. The flow of water is also an indicator of when the auger ceases to bore; that is, when it is fully charged with whatever strata it is boring through. The core of earth rises in the auger till it reaches the diminishing socket, when it effectually stops the water rising through the rods, and leaves the crown rotating on the bottom without cutting, inasmuch as it cannot proceed further in its downward direction, in consequence of the diminishing socket resting upon the top of the core. Then comes the process of drawing the core, and this is a very tedious operation. By reversing the motion of the engine, the boring rods rise instead of descending, and are unscrewed length by length till the auger at last makes its appearance. This labour, at the depth of the boring on the occasion of the visit, occupied about one hour and a half; the same time being consumed in lowering the auger to recommence work where it had left off. But, how is the core snapped from its bed, and brought up in the auger? This is done by a very simple contrivance. A steel wedge, of about nine inches in length, and an inch and a half wide at the top,—tapering from a knife-edge at the point, to about half-an-inch thick at the base,—is fixed inside the auger. As the core rises in the auger, inside of which it has from one to two inches play, it is pressed on one side by the wedge; and, being thus thrown out of the upright, readily snaps asunder, when, resting upon the flanged inside edge of the crown, it is easily brought to the surface. The auger is 25 feet long, and brings up about 23 feet of core each time; not all in one piece, but of various lengths, according to the position in which the wedge is placed. There is one long piece in the Brighton Museum, but Mr. Willett showed his visitors a perfect column 7ft. 6in. in length. As a matter of course, the depth obtained each day varies with the substance pierced. The limestone has been the hardest, and the Kimmeridge clay the softest yet found; and the penetration has varied from a quarter of an inch to two inches and a half per minute. Numerous difficulties have had to be contended against, not the least of which has been the fracture of cores caused by fissures in the strata, when small wedge-like pieces would fall between the core and the inner side of the auger, which, being gradually choked up, has ceased to rotate round the core itself, thus giving the boring rods a violent and sudden twist. Another difficulty met with has been the crumbling of the earth round the outside of the auger, which has necessitated lining the bore with tubes, not a very unimportant item in the expenditure. Lining tubes,—the lengths being screwed and fitted to each other,—had been put down to a depth of 1,130 feet! the weight of metal alone being eight tons! and the most successful piece of lining performed was in putting down 900 feet in 24 hours without an accident.

Some very interesting specimens of the strata gone through—including one composed entirely of oyster-shells, obtained at a depth of 1,130 feet,—were shown; and many pieces were brought away as mementoes of the visit.

Only a few yards from the Sub-Wealden Borings, a shaft has been sunk by a Company for working, as a commercial speculation, the gypsum beds which the Exploration Committee discovered; and a short visit was paid to these works. The sinking of the shaft has reached a depth which brings the works under the Mining Act, with the clauses of which the Government Inspector had called upon the Company to comply, such as steening the main opening to the pit, forming ventilating shafts, &c.; and it is the first work in Sussex which has ever been brought under the Mining Act. The gypsum bed bored through by the Exploration Committee is about 50 feet thick, and lies only about 100 feet below the surface. Some members of the Company suggested putting down a tramway from the pit to the railway at Battle; but no preparation has yet been made to construct it; a more prudent idea having, probably, been mooted and acted upon, viz., the raising of some two or three thousand tons of the gypsum first, in order that it might be seen what they had to carry.

The works—both of the Exploration Committee and the Gypsum Company—lie in a very deep hollow of the wood; so deep, in fact, that the only thing visible but the works is the blue sky overhead; and Mr. Willett explained that one great advantage gained by selecting this site was, that the same stratum was touched at 1,200 feet which could only have been reached by boring 3,000 feet in Archer's Wood, where the boring would have been at an angle.

There being nearly an hour to spare, the party resolved upon acting upon Mr. Willett's suggestion to visit a "petrifying spring" in the neighbourhood; he undertaking to act as guide.

The visit to the spring took longer than expected; so, rather later than had been arranged, the party, after partaking, at Mr. Willett's invitation, of refreshments at Netherfield Vicarage, where that gentleman was staying, returned to Hastings by road, reaching the Swan Hotel, High Street, at a quarter to six, where they found an excellent repast waiting for them. Mr. Alderman Cox, the President, presided, Mr. Alderman Mayall and Dr. Ward occupying the vice-chairs. In consequence of time being so short, the usual formal speech-making was dispensed with, but the company did not separate without first drinking the health of the President, the Hon. Secs., and Mr. Willett, and thanking them for what they had done for their enjoyment. Hastings was left by the 7.20 train, and Brighton reached shortly after nine, after a pleasant day's outing.

alumina in equal, and iron, lime, and magnesia in much larger proportions, with also a great variety of other elements as occasional constituents; while the denser metals are in larger proportion in the more central portion of the nucleus. The suggestion of Mr. Lockyer is that the order follows necessarily from the original localization of the earths and metals before referred to, by which the oxygen, silicon, and other metalloids formed, as they now do in the sun, an outer atmosphere, succeeded by an inner one consisting in greater part of the alkaline earths and alkalies, then by a lower one of iron and its associative group of metals, and finally by an inner nucleus containing the other and denser metals."

One thing which distinguished iron from all other metals was its almost universal diffusion through the rocks of the earth. It was difficult to open our eyes out of doors and not see some tint which was due to its presence. It was, in fact, the great colouring matter of nature. It gave the redness to the bricks of which our houses were built, and the dark purple to the slates of our roofs. The amber tint of the sands on the sea shore was due to it, and the ruddy hue of the newly-ploughed field. All the many shades of yellow, brown, and red, which gave that picturesque tint to the great rock masses of the earth, were imparted by iron, as well as the scarlets and crimsons of agate, bloodstone, and cornelia. Finally, if the red colour of the blood be not entirely due to iron, it was in some manner intimately associated with it. And yet, notwithstanding its almost universal diffusion, there were few things more rare than a specimen of pure iron. A piece of fine pianoforte wire was as free from impurities as iron was generally made. Thanks, however, to the kindness of W. C. Roberts, Esq., the Chemist to the Royal Mint, he had the pleasure of showing them that evening, one of the very few specimens there were in the world. This was obtained by electrolysis. On the table they would also see a fine specimen of a meteor that fell in Mexico, in which the iron was tolerably pure.

This metal, then, not being known to us native, in what combinations did it principally present itself to us. Generally speaking, in union with oxygen. With this gas it combined in several proportions. The three principal ones were, one of iron and one of oxygen, two of iron and three of oxygen, and three of iron and four of oxygen. When a mass of rock contained as much as

25 or 30 per cent. of ferric oxide we called it an *ore* of iron, though a very poor one, for all metallurgical purposes. These three oxides differed very largely from one another in many of their properties and qualities. By a few simple experiments, he could make the chemistry of this part of the subject clearer to them. The first oxide was unknown in its free state, but in the precipitate they saw it in combination with a molecule of water or as a hydrate. In the tubes he had some very nearly pure iron, which he had prepared from its oxide by means of hydrogen. The metal was there in a state of very fine division. He shook it out on a piece of warm metal. It took fire instantaneously, and, in burning, became the oxide known more commonly as rust. The iron had, in fact, rusted very quickly. In the place of the brilliant metal, we had a mass of reddish earth. In this solution iron was dissolved in an acid. The addition of a little alkali would separate the iron from the acid, and the precipitate was the same oxide as had been produced by the union of the iron with the oxygen of the air. Once more he would plunge steel wire into a vessel of oxygen. The iron was now glowing white hot, and the globule was a compound of iron and oxygen, in the proportion of three of the metal to four of the gas. It was very different from the others, being black instead of red, and, besides, it was magnetic. But they would, perhaps, ask if these three oxides formed the basis of all the ores of iron, whence all the perplexing variety of specimens on the table before them? The answer was, these ores differed from one another mainly in the combinations of the oxides with the elements of water, with carbonic acid, and with one another.

It would be better, perhaps, to take the specimens in order, and explain them as he went on. The greenish-grey stone was a specimen of the celebrated Cleveland iron-stone. It was a protoxide of iron combined with carbonic acid. The oyster shell imbedded in the mass told of its marine formation. It was, in fact, from the lias. It might give them some little idea of the enormous extent to which this stone was worked, when he told them that, according to the Government returns, out of the 12,000,000 tons of stone raised in Great Britain in 1871, no less than 5,400,000 tons were from the Cleveland district. It contained about 32 per cent. of iron. Much of the best Staffordshire ore was also a carbonate, and, as they would see, resembled in colour, though not in texture, the

Cleveland. The pretty crystalline variety, called spathic carbonate, was from the Brendon Hills, in Somerset. It was of great value for making spiegel-eisen. Lastly, the nodules, stuck in places in the soft shales of the Yorkshire coast, as if a vessel out at sea had fired them, instead of cannon balls, were also a carbonate of iron. Next they came to the beautiful red hematite of Cumberland and North Lancashire. Of this pure and valuable ore one million tons were now raised annually in the Cumberland district alone. The map before them would show them how the hollows and veins in which it was discovered were scattered over the mountain limestone. Much of the ore was in a state of fine division, and the kidney-shaped, fibrous, and crystalline masses were scattered through the softer earth. It was almost a pure sesquioxide of iron, containing 90 to 98 per cent. of the oxide, or 66 per cent. of the metal. The glittering particles of micaceous iron were the same substance in the crystalline form. There was a mass of the crystals from the lava of Vesuvius, another from a vein of Norwegian quartz, and another was of the well-known resplendent crystals of the Isle of Elba. They now came to the brown hematite. The ore was more generally diffused than the red. The basis of it, however, was the same, the difference being principally in the proportions in which the sesquioxide was united with water. The Forest of Dean supplied, perhaps, the largest quantity of this ore worked in England. It was also found in Cornwall. Such a specimen as that before them contained about 86 per cent. of the oxide. The oolites of Northamptonshire furnished also large quantities of brown hematite. The botryoidal mass, the thin shining plates, and the glittering prisms, were the same substance in a state of crystallization. These last contained some 11 per cent. of water. Thirdly, and lastly, they came to those nearly black, or steel grey, ores which, like iron itself, attracted the magnet and deflected the needle, hence called magnetic ores. These often contained large quantities of titanic acid. Great Britain was very poor in these ores, Sweden and Norway very rich. They were imported in large quantities into England. The best iron in the world was, perhaps, made from them. They sometimes contained 72 per cent. of metallic iron.

They now came to the next important part of the subject—in what manner were those ores of iron deposited in the rocks of the earth. The vast masses of iron ore in the world occurred in rocks of whose aqueous origin there was no doubt. But then they were met with the fact that iron was insoluble in water, and nearly every one of its oxides as well. A spring not far from their doors would, perhaps, help to some extent in solving the problem. He had a bottleful of the water. It tasted of iron, that showed that the metal was dissolved in it. But at the bottom of the bottle they would perceive certain red grains. This was, to all purposes, iron ore—a red hematite. How was the iron dissolved in the water? The answer was, by the agency of the carbonic acid contained in it. When, as in the well, the water came in contact with the atmosphere, the carbonic acid escaped and the iron was deposited as a sesquioxide. Down in the chalk, in the fissures and hollows where the water came to supply the spring, were, he doubted not, large deposits of this red oxide. Here they had, he thought, on a small scale, what, in times gone by, went on on a large one. Look at that map of the hematite district of Cumberland and Lancashire. Those red marks on the map told you where were the fissures and hollows in the mountain limestone, in which the hematite ore was found. The hematite which filled the deposits resembled a huge chemical precipitate. For the most part, the ore consisted of minute particles, generally not very firmly connected, and of a soft nature, in which larger and harder pieces were imbedded. Where on the map the red marks were thickest, there the strata had been much dislocated, and there, consequently, the hollows and fissures were more numerous. Given a carbonate of iron, or carbonic acid, *ad libitum*, and the difficulty of accounting for those vast masses of oxide of iron was at any rate lessened. Yet, although we could not see our way clearly to account for this enormous quantity of carbonic acid which was in combination with iron, yet we must remember that this gas formed a large proportion of primary, secondary, and tertiary rocks. The lias rock, which furnished nearly one-half of the twelve millions of tons of iron ore raised in great Britain, was carbonate. The rich black-band ore of Scotland was also a carbonate. The Cleveland stone was associated with animal remains, the black-band with vegetable. Had we any evidence to show us how living beings could aid in the deposition of iron? Assuredly we had. He learnt from the official report of the Swedish Chamber of Commerce that 13,476 tons of lake ore were obtained in 1870. "This is found as a deposit at the bottom of shallow lakes, from which it is dredged up; this peculiar ore is formed by the action of microscopic organisms, which extract the iron from the water in which it is held in chemical solution; the bottoms of these lakes pertain to different owners, and are divided into sections, which are alternately dredged after an interval of some years' repose, during which the iron ore again accumulates." If so large a quantity of ore as that stated above could be raised over a small area, and in a comparatively short space of time, what must be the amount which huge lakes and long centuries of repose would afford?

He would now call their attention to the fine crystals before them in a mass of quartz from Norway, and the same substance in a block of lava from Vesuvius. They might ask how he reconciled the crystals in lava with an aqueous theory of deposition. He answered that Mitscherlich had shown that the substance forming these crystals had not been subdued by the action of intense heat, but generated by contact at a high temperature of the vapour of water and that of sesquichloride of iron. The presence of these crystals in quartz was strong evidence of the part which water has played in the genesis of the rock itself. Even the magnetic oxide which they saw, formed by the union of iron with oxygen, with the production of an intense heat, could also be obtained from a solution of iron. The problems, however, connected with his subject, were still many and perplexing, but the light seemed dawning on us by degrees; and now that astronomy, geology, and chemistry, alike brought their forces to bear upon the subject, the time could not be far distant when we shall see clearly, where now we but dimly groped our way.

On the motion of the President, Mr. Alderman Cox, a vote of thanks was accorded to Mr. Pankhurst for his paper, and the trouble he had taken in illustrating it by experiments.

Before the conversation on the paper was opened, the CHAIRMAN suggested that, in order to facilitate discussion on subjects treated before the Society, short syllabuses of the papers read should be published on the notices convening the meetings. It was decided that the suggestion should be acted upon, as far as practicable; that was, that those who could, and had time to, prepare syllabuses of addresses when they delivered any, should do so, and the Society would be thankful for them.

An interesting conversation was then commenced, and carried on for a considerable time, the Rev. J. H. Cross, Mr. Wonfor, Mr. W. Saunders, Mr. Sawyer, Mr. F. Phillips, Mr. R. Glaisyer, and others, taking part in it.

Previous to the reading of the paper, the meeting was informed by Mr. F. E. Sawyer, that he had found two more mammals since he read his paper on "The Birds and Mammals of Sussex," in April —namely, Bank vole *(arvicola riparia)*, common in the Weald in wooded places; and beach marten *(mustela martes)*, shot in 1826 at Holmbush, Horsham; making up the total of Sussex mammals to 31.

Mr. SAWYER also directed attention to a paper read before the Eastbourne Natural History Society by Mr. Roper, the President, in which he rather severely criticised his (Mr. Sawyer's) paper on "The Mammals and Birds of Sussex." He prefaced his reply to the criticism with the explanation that in his paper he gave the authorities, and the dates and places, relating to the birds mentioned, while Mr. Roper did not. Notwithstanding this, Mr. Roper found fault with him for not examining certain books for information which he had examined; Mr. Roper observed that he had stated that the Gyr-Falcon was not a British bird, and that he had not searched the works of Montague, Yarrell, and Selby, which mentioned it as such. This he had done, but had also learned that in two or three museums birds were termed Gyr-Falcons, which were not so; and that in Harting's list, published in 1872, and, therefore, the most recent, the Gyr-Falcon was omitted from the list of British birds.

The CHAIRMAN characterised indulgence in negative statements, such as those of Mr. Roper, as a very thoughtless practice, and very false reasoning; and Mr. Wonfor expressed his opinion that Mr. Sawyer deserved credit for his research and the discovery he had made with regard to the Gyr-Falcon, and that his reply to Mr. Roper was satisfactory.

AUGUST 12th.

ORDINARY MEETING.—MR. T. W. WONFOR ON "WORK OF THE SOCIETY."

It would be in the recollection of some of the members of the Society that in April, 1873, he read a paper before the Society on the "Verification of the Fauna and Flora of the County of Sussex," in the course of which the following suggestions were made:—

"First, as to the Society collectively—that the Brighton Society became the conservator and depository of all lists which might be entrusted to it, from time to time, by its own members, by other kindred Societies, either in or out of the county, and by naturalists generally; the question of publication of such lists, and in what form, to be determined at some future period, *i.e.*, either by the Society alone, or by assistance from without.

"Secondly, that it appoint sub-committees, from time to time, to collate and compare the different lists sent in.

"Thirdly, that it invite the co-operation, in carrying out these objects, not only of naturalists within the county, but of all who had been known to work in any particular branch, and especially to request information respecting new species.

"Next, as to the members individually—that all who had worked, or were working in any particular branch of Natural History—should contribute lists, with the *approximate* localities of all species of plants or animals they had met, or might meet with, in the county of Sussex, noting in each case, whether, in their opinion, the specimens were common, rare, or local, together with any facts respecting particular districts or localities in the county, in which each specimen was found, with time of appearance. This would especially refer to land and fresh-water plants and animals. In regard to the Marine Flora and Fauna, the times and seasons when found, should in every case be given, because so little was absolutely known at present of the times, seasons, and changes of most marine plants and animals."

In accordance with a resolution passed at the meeting, the Committee sent a circular to all societies and known naturalists in the county, and to those gentlemen out of the county who had been known to have worked in any particular branch of natural history in the county. The result up to the present time has been almost *nil*, for, except Mr. F. E. Sawyer's admirable paper on the "Mammals and Birds of Sussex," and the Rev. Mr. Bloomfield's paper and lists of the Lepidoptera of Guestling, the Committee had literally received nothing from either the members of this or any other society. In the meanwhile, Eastbourne had published lists of the Fauna and Flora of its district, Mr. Roper a separate work on the Flora of Eastbourne, and the Lewes Society proposed the publication of lists of their district.

Under these circumstances, he considered it behoved the society to bestir itself, and see whether some definite plan could not be adopted by which all the facts known might be brought together, and so an authentic record be obtained of the Natural History of the county of Sussex, to which, as the departments of Meteorology and Palæontology were so intimately connected with present and past life, these two subjects should be added. The plan he proposed for the society's consideration was the appointment of sub-committees, consisting of three or four gentlemen known to take an interest in any particular branch, with power to add to their numbers others, whether in or out of the society, as corresponding members, each sub-committee reporting periodically the results of its labours. By this means some definite work would be accomplished, and, when facts of a sufficiently important character had been accumulated, steps might be taken for giving to the world the result of their labours in such a shape as the society might deem best.

One sub-committee might very fairly take charge of the Meteorology and Geology of the county. He considered rainfall, together with atmospheric disturbances, the silting up of the rivers and the alterations in their channels, would connect meteorology closely with geology; while the wearing away of the cliffs, the encroachment of the sea in the one part and its retiring in another, as physical changes still going on, should receive the due attention of this sub-committee, who would also endeavour to make a list of all fossils reported as found in the county, as well as plans or sections of any interesting facts brought to light by cuttings or excavations. The great problem being solved by Mr. H. Willett and the Sub-Wealden Exploration Committee, in the east of the county, would be a subject for present work; while the magnificent collection of chalk fossils in the Brighton Museum, made and presented to the town by Mr. H. Willett, and rightly designated "The Willett Collection,"—and of which a catalogue was in existence, would form a nucleus for the formation of a list—and Mantell's collection—alas, no longer in the county, but of which information could be obtained—indicated the direction in which, in his opinion, a sub-committee taking under its charge the two subjects of meteorology and geology might very profitably work. The maps of the county, published by the Survey, and showing the geological formations, would be of great use to such a committee.

There was another very important subject which ought to be entrusted to a separate sub-committee, viz., "The Anthropology of the County of Sussex," The functions of the committee would, he thought, in no way trench upon those of that society whose annual meeting had been held that day at Lewes, viz., the "Sussex Archæological Society," though some points it might have to consider would be identical with those published in that society's collections, which would be of very great service to this committee.

He need scarcely remind the members of the society that many and different peoples had, at different times, inhabited the county; whether under the names of pre-historic Britons, the palæolithic and neolithic stone-implement-using men, invaders from Gaul, who settled on our southern shores, and whose cromlechs or temples, such as that at Stonehenge, testified to their religious rites and ceremonies. The so-called god, the "long man" at Wilmington, would be a very natural subject of inquiry, as to whether it really was what it had been described, or rather the work of the mediæval monks. Good service had been done by one of their members—Mr Ernest Willett—by his excavation at Cissbury, the account he gave of which must be fresh in the memory of the society, who would be glad to hear his views had been confirmed in a remarkable degree by the excavations of Colonel Lane Fox and others, but still, much more remained to be done in the county in relation to the period to which Cissbury as a flint-implement factory, belonged. Then the Romans, with their four hundred years of occupation, had left many interesting facts which needed classification and arrangement, so that what belonged to them, might be separated from the people who preceded and succeeded them in the occupation of the county. Then there were the Saxons, different tribes of whom settled in the county and impressed on it its name, and whose chiefs were rightly or wrongly credited with giving names to many towns and villages; next they had the Danes, a very interesting enquiry in connection with whom might fairly be considered, viz., whether the amber cup upstairs, the bronze dagger, the stone axe and whetstone found in a barrow at Hove, were rather the property of a Danish Chief killed and buried in Hove fields, and not, as had been and was stated, the weapons and property of a British Chief; and last, though not least, the Normans, who, like most of the invaders of this island, landed on the south coast in the county of Sussex, each and all of whom had left marks and characteristics which ought to be worked out as a department of Anthropology. If nothing more were done in this direction, at least what did not at present exist might be drawn up, viz., a map of Sussex, similar to that which Mr. Warne has made of the county of Dorset, giving the situation of Druidical or quasi-Druidical remains, camps, stations, castles, roads, tumuli, beacons, battle-fields, &c., indicating in each case by different colours whether they were British, Roman, Saxon, &c., and possibly out of it might come strength to the hands of those who wished to conserve our national monuments.

Next came what some might say were more strictly the functions of a Natural History Society, viz., the Botany and the Zoology. The first, Botany, ought to have a separate and distinct Committee, who should undertake both the phenogamic and cryptogamic flora of the county. The society had published a Moss Flora, complete as far as our knowledge went when it was published; but, by the labours of Messrs Davis and Mitten, additions had been made to that department. Mr Roper had published the Flora of Eastbourne this summer, and other gentlemen were writing out lists of the phenogamous plants. Now, a committee composed of three or four of their members whom he could name, would be able to compare, say the London Catalogue, with the labours of others, and add from time to time such, either new or re-discovered plants, as might from time to time crop up. Perhaps, too, as good a list of the lichens and algæ might be drawn up as of the mosses. One point he thought this committee should bear in mind. No Flora of the county could be deemed complete which excluded the cryptogams.

Turning to the subject of Zoology, a little difficulty arose, because, while the subject naturally divided itself into the vertebrates and the invertebrates, it would be with the latter that the greater difficulty would be encountered. Certainly two, possibly three, sub-committees would be necessary to undertake this work with anything like satisfaction. Mr. F. E. Sawyer had done so much to clear the way, by his admirable paper and lists of the mammals and birds, that very little more than to add new species and verify recorded ones would have to be done by that section which took vertebrate zoology. He knew it was foreign to the subject, but possibly they might include in their labours the mollusca, *i.e.*, the land and fresh water snails and slugs.

If so, then one sub-committee might take the insects and the spiders, both of which were well represented in the county; in fact, few counties of England were so rich in Entomology as the county of Sussex. There were plenty of entomologists, but the majority had paid more attention to *lepidoptera* and *coleoptera*, but there were some few gentlemen in Sussex who had devoted considerable attention to the *diptera*, &c., and doubtless, their co-operation might be obtained in so good a work as the verifying and establishing the entomology of the county.

Some might say nothing had been mentioned in respect either of the Microscopic Fauna and Fauna, nor yet of the Marine, but the latter would doubtless be taken in hand by the botanists and zoologists, while it would be a difficult matter to define the limits of microscopical research. Any way, should the society see fit to appoint a microscopical sub-committee, the result of their labours might give an impetus to work with the microscope among those members of the society who, possessing instruments, did not work systematically at any branch of enquiry, and who might be stimulated, if a committee took this under its especial care. What he had briefly stated he considered might fairly be undertaken by the several committees he had named—viz., Meteorology and Geology; Anthropology; Botany; Vertebrate and Invertebrate Zoology. He threw down these ideas for discussion by the members, and should the society approve of his suggestions, a modification of them, or some other plan which would accomplish the same object, he would endeavour loyally, and to the best of his ability to assist in so good an object as the obtaining a correct record of the Natural History of the county.

The CHAIRMAN proposed a vote of thanks, remarking that it was very desirable that they should systematise the society.

Mr. DENNANT regarded the paper as likely to exercise a wholesome influence over the future work of the society. A large number of the members were but learners, and he thought the project was an admirable one for bringing out their powers. It was quite hopeless to attempt to master all the branches of natural history, and the best they could do was to form into little departments for the study of various subjects. It appeared to him that if this plan were carried out, it would be helpful in every respect. It would enable their leaders to prosecute their work with the feeling that they were spending their time and talents to some real advantage, and the less learned to select a congenial study. He had often thought how pleasant it would be to work in this manner; and he knew of no plan so calculated to utilise the whole of the members. It was desirable that it should be understood that although accomplished *savants* were welcome, they were also glad to have earnest, but comparatively ignorant, workers with them. The monthly excursions would doubtless be rendered more interesting and instructive. He fancied it would greatly enhance the enjoyment of them, if some member were appointed to prepare and read a short but exhaustive paper on the objects of interest in the neighbourhood.

Mr. C. F. DENNET approved of the suggestion contained in Mr. Wonfor's paper, and bore testimony to the value of the society. They all had an aptitude for some particular pursuit, and it was very important that they should be able to cultivate their respective tastes. He believed, if the plan were followed, it would prove of great service.

After a further discussion, in which several members took part, Mr. DENNET gave notice that, at the annual meeting, he would propose a resolution to the effect that sub-committees be appointed to undertake the various branches of study indicated in Mr. Wonfor's paper.

Mr. F. E. SAWYER observed that their studies in anthropology might induce the Sussex Archæological Society to take more notice of Brighton, and, perhaps, to hold its next annual meeting there.

AUGUST 26th.

MICROSCOPICAL MEETING.—"MARINE LIFE."

The subject announced was "Marine Life," but, owing to the rough weather, no living specimens were forthcoming, and the members had to content themselves with the slides bearing upon the subject belonging to the society. Before these were submitted to view, the honorary secretary (Mr. T. W. Wonfor) stated that he had received from Mr. T. Curties, Holborn, copies of the 80th and 81st Journals of the Royal United Service Institution, in which were some beautiful delineations of minute sea-surface animals in coloured drawings by Mrs. Toynbee, with instructions to naval officers how to obtain similar collections. Mr. Wonfor added that either the form of tow net mentioned in the journal, or that suggested by Mr. Hennah some time since, might be very usefully employed off the Brighton piers, or drawn after an ordinary sailing or row boat. Many interesting, if not new, forms of life would be met with in this way, as well as the ova of many fishes, which would enable them to watch the gradual development of life.

After a few remarks from the Chairman (Mr. J. E. Haselwood, Vice-President), the meeting became a Conversazione, when slides bearing on Marine Life were examined; among others, specimens of ooze obtained from the bed of the Atlantic ocean by Dr. Carpenter, in the Porcupine dredgings.

A very fine grasshopper was also shown by Mr. G. D. Sawyer, who had caught it the same evening at Cliftonville.

LIST OF MEMBERS

OF THE

Brighton and Sussex Natural History Society,

SEPTEMBER, 1875.

Abbey, H.
Ardley, W.
Aylen, S.

Badcock, Dr.
Baldrey, George
Balean, H.
Beavan, J.
Bellingham, C.
Benifold, J. S.
Bigge, A.
Black, Arthur
Booth, E.
Boxall, W. P.
Bright, E.
Brown, J. H.
Browne, Hon. Howe
Browne, G.
Burford, Rev. F. W.
Burrows, Sir J. Cordy
Busby, R. A.

Capon, J.
Carpenter, Charles
Challen, J.
Clarke, A.
Clarke, W. T.
Clayton, C. E.
Clowser, J. H.
Cobb, R.
Cobbett, J.
Colling, J. H.
Cooper, T. J.
Corfe, Dr.
Cox, A.
Cox, A. H.
Creak, A.
Cross, Rev. J. H.
Curtis, J.
Cutton, T.

D'Alquen, F. M.
Davey, H.
Dawson, Dr.
Day, G. H.
Deane, W.
Dennant, J.
Dennet, C. F.
Dixon, J. L. M.
Dowsett, A.

Eberall, J.

Fisher, A.
Fowler, T.
Fox, O. A.
Friend, Daniel
Friend, D. B.

Glaisyer, J. H.
Glaisyer, R.
Glaisyer, T.

Goss, H.
Gower, H. K.
Gwatkin, J. T.

Hack, D.
Haddock, G. J.
Hadlow, F. V.
Hall, Dr.
Hallett, W. H.
Hallifax, Dr.
Hamblin, E.
Hamilton, C. C.
Harris, E. H.
Hart, E. J.
Haselwood, J. H.
Hauxwell, Dr.
Heald, C. J.
Hennah, T. H.
Henty, W.
Hilton, W.
Hobbs, J.
Holford, F.
Holford, G.
Hollis, Dr.
Hollis, W. M.
Horne, T. B.
Hurst, H.

Image, Rev. J.
Infield, H. J.
Ingle, Dr.
Ireland, A.

Jackson, A. W.
Jackson, W.
Jeffcoat, J.
Jeffreys, W., Jun.

Kenyon, J. H.
King, Dr.
Knightley, Dr.

Lawler, —
Lee, J. S.
Lee, W. R.
Leigh, T.
Lethbridge, E. B.
Leuliette, L.
Loader, A.
Lomax, Benjamin
Lomax, O'Bryen
Lucas, A.
Lucas, J. E.

Mahomed, F.
Marshall, E. J.
Massy, Dr. Tuthill
Mayall, J. J. E.
Maydwell, R. L.
Medcalf, E. S.
Merrifield, F.
Merrifield, J.
Millard, W. J. K.
Mills, P.
Mitchell, W. W.
Moore, E.
Morris, J.
Moseley, Rev. T.

Nash, George
Nash, W. H.
Nell, W. T.
Newth, Dr.
Newton, Rev. J.
Nicholls, W. H.
Nourse, W. E. C.

O'Connor, D.
Onions, J. C.

Page, T.
Paine, C.
Pankhurst, E. A.
Parsons, F. C.
Payne, F. W.
Peek, R.
Penley, M.
Phillips, B.
Phillips, F. B. W.
Pinker, H. R.
Pocock, C. J.
Pollard, T.
Pratt, H.
Pugh, Dr.
Puttick, W.

Richards, D.
Ridge, J.
Roper, F. C. S.
Ross, Dr.
Rowsell, C. J.
Rutter, Dr.

Sadler, J. H.
Salt, Rev. F. G.
Saltzmann, F. W.
Saunders, Hubert
Saunders, W.
Savage, W. D.
Sawyer, F. E.
Sawyer, G. D.
Saxby, Mr.
Scott, E.
Shaft, G. T.
Shilbeck, J.
Shillingford F.
Simonds, T. R.
Smith, C. P.
Smith, Frederick S.
Smith, J. P. M.
Smith, T.
Smith, Walter
Smith, W. H.
Stevens, W. G.
Strevens, W. H.
Stride, J. W.

Tainsh, E. C.
Tatham, G.
Trenchard, J. A.
Tuke, J. K.

Upperton, R., Jun.

Verrall, H.
Verrall, Hugh

Wailes, Dr.
Walker, Captain
Wallis, E. A.
Wallis, M.
Wallis, W. C.
Warden, E.
Ward, S. N.
Waterman, W. H.
Watson, W.
Willett, E. H.
Willett, H.
Williams, H. M.
Wills, James
Wilton, W.
Winter, J. N.
Wonfor, T. W.
Wood, J.
Wood, W. R.
Wood, W. R., Jun.
Woodman, J.

HONORARY MEMBERS.

Bloomfield, Rev. E. N., Guestling, Hastings.
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Curties, J., 244, High Holborn, London.
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Latham, Dr. K. G., London.
Lee, H., Croydon.
Mitten, William, Hurstpierpoint.
Prince, C. L., Uckfield.
Smith, Professor, Cork.
Stevens, Dr., St. Mary Bourne, Hants.
Ward, J., Clifton, Greata Cottage, Keswick.

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex officio* Honorary Members of the Society.

Belfast Naturalists' Field Club.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Club.
Eastbourne Natural History Society.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
Quekett Microscopical Club.
Smithsonian Institution, Washington, U.S.A.

TREASURER'S ACCOUNT,

FOR THE YEAR ENDING SEPTEMBER 1st, 1875.

Dr.				£	s.	d.
To Books and Periodicals				29	4	2
„ Printing,—						
Circulars, &c.	£8	19	0			
Reports	24	15	0			
				33	14	0
„ Stationery and Postages...				7	7	9
„ Insurance				0	12	0
„ Messenger for delivering notices				2	15	6
„ Commission to Collector for Subscriptions ...				3	0	6
„ Donation to Assistants at Museum ...				2	2	0
„ Book-binding				0	17	7
„ Memorial to the late Mr. G. Scott's family ...				3	9	6
„ Frame for Diagrams						
„ Spirit for Lamps						
„ Sundries						
„ Expenses						

Cr.	£	s.	d.
By Balance from last year	0	2	0
„ Annual Subscriptions due on September 1st, 1874	82	0	0
„ Arrears due September 1st, 1873	7	10	0
„ Entrance fees	10	10	0
„ Sale of copy of Moss Flora	0	0	9

THE TWENTY-THIRD

ANNUAL REPORT

AND

ABSTRACT OF PROCEEDINGS

OF THE

BRIGHTON AND SUSSEX

NATURAL HISTORY SOCIETY,

ADOPTED AT A MEETING HELD

ON THURSDAY, OCTOBER 12TH, 1876.

PRICE ONE SHILLING AND SIXPENCE.

BRIGHTON:
PRINTED BY FLEET AND BISHOP, "HERALD" OFFICE.
1876.

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MR. E. H. WILLETT,
MR. J. WILLS,
MR. ALDERMAN MAYALL,
MR. A. DOWSETT.

Honorary Secretaries:

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38, Buckingham Place.

MR. J. C. ONIONS,
56, Middle Street.

Honorary Librarian and Curator:

MR. ROBERT GLAISYER,
The Dispensary, Queen's Road.

At the Twenty-third Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church-street, October 12th, 1876,

IT WAS RESOLVED,—

That the Report, Abstract of Proceedings, and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the cordial thanks of this Meeting be given to the Honorary Secretaries, Honorary Treasurer, and Honorary Librarian, for their labours in preparing the same.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Mr. G. D. Sawyer; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. Benjamin Lomax, Mr. Dennet, Mr. Ernest H. Willett, Mr. J. Wills, Mr. Alderman Mayall, and Mr. A. Dowsett. Honorary Secretaries: Mr. T. W. Wonfor and Mr. J. C. Onions; Honorary Librarian and Curator, Mr. R. Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

(Signed) JOHN DENNANT,
Chairman.

IT WAS ALSO RESOLVED,—

That the warmest thanks of this Meeting be presented to Mr. J. Dennant for his able conduct as President during the past year.

REPORT.

In presenting the Twenty-third Annual Report your Committee have the pleasure of again recording the continued prosperity of the Society. They deeply regret the loss which the Society has sustained by the death of two of its Vice-Presidents, viz., Mr. T. H. Hennah and Sir J. Cordy Burrows; the former was one of the earliest Members of the Society, and had always taken a very active part in promoting its prosperity, and in the diffusion of scientific knowledge, particularly in those branches of science which depend upon the use of the microscope.

The state of the finances continues to be satisfactory; the sum of £4 18s. 4d. remains in the hands of the Treasurer, after expending £28 16s. 3d. in the purchase of new books and periodicals. The number of members has slightly increased during the year. It is also gratifying to the Committee to report that the Society is becoming much more widely known; the number of similar Societies in correspondence with it, both in this country and America, has considerably increased.

Presentations of the following Books have been received by the Society during the year, viz.:—On the Comparative Microscopic Structure of Ancient and Modern Volcanic Rocks, and on the Granitic, Granitoid, and Associated Metamorphic Rocks, three pamphlets (by J. C. Ward); On the Outline of the Flora of Sussex (by W. B. Hemsley); On Turf Carvings (by Dr. J. Stevens); A Lecture on the Geology of Croydon (by J. Morris); two pamphlets on the Chalk Cliffs of Eastbourne, and of Dorset and Devon, by W. Whitaker (from their Authors); Observations on the Genus Unio, 7 vols. (by Dr. J. Lea); Materieux pour la Paleontologie Suisse, by T. J. Pictet, 2 vols. (from Mr. T. Davidson); The Human Race, by L. Figuier (from Mr. C. Paine); Annals of Philosophy, by Thomson and Phillips, 28 vols. (from Mr. J. H. Glaisyer); Two Addresses before the Geological Society of London, by J. Evans; Quarterly Journal of Geological Society for 1871; Free Trade (by Cobden Club); Reforme Economique (1875, 1876); The Coinage of the Ancient Britons (by J. Evans); On Siliceo-fibrous Sponges (by J. S. Bowerbank); Geological Record for 1874 (by W. Whitaker); On Landslips, by Conybeare and Dawson (from Mr H. Willett); Report of Smithsonian Institution for 1874; on the Zapus Hudsonius and White Tailed Ptarmigan (by Dr. E. Coues); 2nd Vol. Crustaceous Vertebrata (by E. D. Cope); Geological Survey of Colorado for 1874 (by F. V. Hayden); Invertebrate Palaeontology (by F. B. Meek); Geometrid Moths, by A. S. Packard (from F. V. Hayden, Geologist in charge, Washington, D.C., U.S.A.; Nebraska (by E. A. Curley) and a Map of the Line (from the Union Pacific Railway Company, U.S.A.); Memoirs of Peabody Academy of Science; Sixth Annual Report of ditto; Check Lists of Ferns of North America, 2 vols.; American Naturalists (from Peabody Academy of Science, Salem, Mass., U.S.A.); Annual Reports for 1873, 1874, 1875, of Belfast Naturalists' Field Club; Annual Report for 1876 of North

Staffordshire Naturalists' Field Club; Annual Report for 1875-6 of Chester Society of Natural Science; Four Parts of Transactions for 1875-6 of Watford Natural History Society; Annual Report and Parts of Journal of Quekett Microscopical Club; Annual Report for 1875 and Five Numbers of Proceedings of Geologists' Association; Two Parts of Proceedings of Natural History Society of Glasgow; Annual Reports (10, 11, and 12) of Lewes and East Sussex Natural History Society; Annual Reports for 1875-6 of Eastbourne Natural History Society; Annual Report for 1875 and other Papers of Leeds Naturalists' Club; Report for 1875 of Brighton Free Library and Museum; Annual Report for 1875-6 of Chichester and West Sussex Natural History Society; Fourteenth Quarterly Report and other Papers of Sub-Wealden Exploration; Report of Cardiff Naturalists' Society (from the Secretaries of the Societies).

The following Books have been purchased during the year, viz.:—Mental Physiology (by Dr. W. B. Carpenter); The Octopus (by H. Lee); History of Ferns (by J. Smith); Vol. I., Parts 1, 2, 3, Botany, and Vol. I., Parts 1, 2, 3, Zoology, and Index to Vols. 26 to 30 of Linnean Society; Jummoo and Cashmir Districts (by F. Drew); Geology for Students (by A. H. Green); Animal Parasites (by Van Benenden); Contributions to Molecular Physics (by J. Tyndall); Climbing Plants (by C. Darwin); Fermentation (by P. Schützenberger); Notes on Collecting and Preserving Objects (by J. E. Taylor); Geology of England and Wales (by H. B. Woodward); The Moon (by E. Neison); Geographical Distribution of Animals (by A. R. Wallace). The Geology of Surrey, Petrifactions, Catalogue of Organic

Remains of Sussex; Osteology of the Iguanodon and Hylaeosaurus; Fossils; Reptiles of South East of England (by G. Mantell).

The number of the Books is now 917, exclusive of unbound current Periodicals and Pamphlets. The Committee are pleased to report that the use of books, both by Members and by the Public in the Reading Room of the Free Library, continues to increase.

As a new Catalogue was required, the system of arrangement has been altered, the classification being by subjects, with a list of the Authors at the end, which plan it is considered will render the reference to works on a particular subject more convenient. Members will be able to obtain the new Catalogues on application.

A donation of seven slides, illustrating different varieties of starch and arrowroot, has been presented to the Society's Microscopical Cabinet, by Mr. W. H. Smith, and also six slides of Polycystina, by Mr. Haselwood.

The Conversazione, held on the 29th February, at the Royal Pavilion, was very successful, a detailed account of it will be found in the proceedings.

The thanks of the Society are due to those gentlemen who have read Papers, exhibited objects, or presented specimens or slides for the cabinet, or photographs or drawings for the Society's album.

The Field Excursions since the last Report have been as follows:—September, 1875, Hayward's Heath; October, Worthing;

May, 1876, Balcombe; June, Isfield; July, Lancing; August, Steyning; September, Berwick.

The Annual Excursion took place on the 6th of July to Petworth.

In concluding their Report, your Committee beg to request the Members to endeavour to promote the prosperity of the Society by bringing its merits under the notice of their friends, by contributions of works of Natural History to the Library of photographs or drawings of objects of Natural History for the album, and of slides for the Microscopical Cabinet, and particularly by reading Papers during the ensuing year.

ABSTRACT OF PROCEEDINGS.

1875-6.

SEPTEMBER 9TH.

ANNUAL MEETING.--MR. C. POTTER ON "THE SO-CALLED FOREST BEDS."

Mr. **DENNANT**, the President, returned thanks for his election, and expressed a hope that the progress of the Society during the year just begun would be very real, and that the efforts of the Members would end in even greater usefulness than hitherto. He also spoke briefly in favour of very short papers by Members who felt some diffidence in reading long ones at their ordinary meetings; and expressed the pleasure he felt in being associated on the Committee with their two able Hon. Secretaries, than whom they could not find better were they to search the country through.

Mr. **POTTER** explained that what he should say would refer principally to the Cheshire shore, not so much because the beds were confined to that coast, as because they were seen there to greater advantage than in any other part of the country. At one time he believed that the whole of the forestal remains so largely exposed on the Cheshire shore, and to be found in corresponding beds in nearly the whole of the marsh lands and river valleys of Great Britain, Ireland, and in many parts of the North of Europe, germinated, grew, and decayed, where they were now found; but having accidentally come upon a small unresinous fir in an undecayed state, underlying the bole of a large oak, both of which were firmly embedded in their surrounding matrix, a doubt at once arose in his mind whether his preconceived opinions were correct. Subsequently, he ascertained that seldom were two of these trunks to be found lying parallel to each other, but upon and crossing each other, often at right angles. He also observed that the roots of the standing butts were as likely to spread out above these prostrate trunks as below them, and further, that the standing butts which were embedded in the lower part were not more than as one to ten of the trunks.

As previous observers appeared now to have noticed these facts, he determined to examine into and satisfy himself on the subject. These investigations caused him to change his original opinion ; he concluded that the whole of the forestal remains found in these beds drifted from elsewhere. Under any circumstances, the tree-trunks and boughs must have been covered up where they were now found by the natural growth and deposition of the fresh water plants of which these beds were formed.

Was it possible to account for these different conditions of soundness, if the fact were excluded that one must have been more decayed than the other previous to embedding ? Strong evidence that the trees exposed on the surface had not grown and been broken down where they were now found was afforded by the fact, that of the hundreds of trees exposed, it was almost impossible to find a prostrate trunk in such a position near a standing butt as would suggest the idea that they might have formed one entire tree. Nevertheless, the smallest roots and branches of these trees were, with their bark and epidermis, in the most perfect condition preserved in these beds ; and it should be borne in mind by those who argued that these trees had lived and died where they were found, that such portions as had grown above the earth, including trunks, branches, &c., would lie exposed to the decaying influence of air, moisture, and insects for an indefinite period of time before they could, from the natural growth of vegetation from below, and the annual fall of the leaves, &c., from above, become covered and buried by a vegetable soil.

The tree butts had sunk through water to where they were found, and the materials of which the beds were made up was gradually formed by deposition. To his mind one fact was in itself conclusive, that these trees could not have grown where they were now seen. The peats being stratified and very finely laminated would give proof or evidence of the intrusion of a foreign body, and he hesitated not to assert that it would be impossible for a root in its first stage of growth as a delicate filament to expand with the growth of the tree until it had attained a diameter of eighteen inches or more and not dispense with or in any way crush the laminæ or stratification above or below. He believed that it was impossible for a tree, under any circumstances, to fall where it had grown, and there remain in a comparatively sound state, whilst a soil derived from the ordinary growth and decay of vegetation accumulated over it.

SEPTEMBER 23RD.

MICROSCOPICAL MEETING.—"POND LIFE."

The President, Mr. J. **DENNANT**, in the absence of any paper on the subject of the evening, "Pond Life," invited those present who had brought objects of interest to give an account of them.

Mr. T. W. **WONFOR** said he had purposed obtaining some specimens from Lewes, but the weather had been so unfavourable that he had not been able to do so. He had, however, procured from a pond on the Furze Hill—which generally proved a fertile source of supply—what proved, on microscopical examination, to be one of a very interesting class of creatures, *Infusoria*, so-called from the forms of life found in various infusions. All *Infusoria* were at one time supposed to be animals, and Ehrenburg, the great German microscopist, had taken a red spot which he called the "eye dot" as a mark of their being so. Many had since been proved to be the early stages of plants. This particular specimen was known by the name of *euglena*, and the "eye dot" was plainly to be seen. Its shape was cylindrical, and the green nuclei might be observed circulating in its body. Its form changed as it moved about, and one that he noticed appeared to have absorbed some particle of some other animal for food. There was not much doubt that it was a true though very low type of an animal. The same pond furnished plenty of cyclops, larvæ of gnats, and many vegetable forms.

Mr. T. **GLAISYER** stated that he had received from a friend an object picked up from the surface of the sea, some 300 miles from Singapore, which he had ascertained to be a portion of a vegetable structure.

Mr. **Haselwood** observed that he had brought some forms of life from Hayward's Heath. From the same place he had carried away some newts, but they had unfortunately died.

The Meeting then resolved itself into a microscopical one, at which were exhibited, in addition to the objects already mentioned by the Members, the following :—

Mr. **Dennant**, the President, diatoms and desmids from the Shoreham marshes ;

Mr. **Haselwood**, a cadis worm and some daphnia ;

Mr. **Puttick**, cyclops, rotiferæ, and minute plants ;

Mr. R. **Glaisyer**, water fleas and wheel bearing animalcuæ.

October 14th.

ORDINARY MEETING.—MR. T. W. WONFOR ON "MANNA."

"In the morning the dew lay round about the host. And when the dew that lay was gone up, behold, upon the face of the wilderness there lay a small round thing as small as the hoar frost on the ground. And when the children of Israel saw it, they said one to another. It is *Manna;* for they wist not what it was." Over this word manna, and what it was, there had been great differences of opinion. He did not purpose entering into any question of a controversial character, nor yet to raise any doubt respecting the miraculous production of food for the Israelites during their wanderings in the desert ; but to indicate first what natural productions had at different times been considered to approach in resemblance the nearest to the Scripture food, and then to show that even now a substance was found, a natural growth, which corresponded with the description given in the Mosaic account.

But first there was a difference of opinion in regard to the term *Manna;* some asserted that, as the word *man* means "what is it ?" it derived its name from the exclamation of surprise uttered when the substance was first seen. It has been urged against this derivation that the use of the term *Manna* in the New Testament as a substance militated against this derivation ; but this seemed of little account, for though a mere exclamation in the first instance, by usage it became a *term* applied to a material substance. Others derived the name from *Manah*, a gift, others from *Minah*, to prepare, and others from *Munakon*, "provision for a journey." It seemed to him that the first was the simplest and most natural derivation, and agreed with the evident surprise with which the Israelites first saw the (to them) new food.

Those who had written about Manna divided themselves, as it were, into two groups, viz., those who took it literally to be a substance, which fell like dew from heaven, *i.e.*, the atmosphere, and those who considered it a vegetable production or a plant itself. Among those who affirmed that the Manna of Holy Writ was a species of condensed dew or honey, they had Salmasius, who said that the *Manna* of the Israelites was only a species of honey, identical in its nature with wild honey, which supplied food to St. John in the wilderness, and that the miracle did not consist in the production of any new substance, but in the abundance and in the regularity in which it was dispensed for the maintenance of so vast a host.

The idea of Salmasius was sustained by Ælian in his work, *De Naturâ Animalium*, where he described a natural phenomenon in India. "In India, and particularly in the country of the Prasii (who extended through the richest part of India, from the Ganges to the Punjaub), it rains liquid honey, which, falling on the grass and leaves of reed, produces wonderfully rich pasture for sheep and oxen ; the cattle are driven by the herdsmen to the spots where they know quantities of this sweet dew have fallen. The animals enjoy a rich banquet on these pastures, and furnish very sweet milk. There is no necessity to mix it with honey as the Greeks do." Athenæus, quoting from Amyntas, who wrote an Indian itinerary, says, Amyntas, in his first book, speaking of the honey from the atmosphere, writes thus : "They collect it with the leaves, making it into the form of a Syrian cake ; some make it into the form of a ball ; and when they wish to enjoy it, breaking off a portion, they melt it in wooden cups called tabetiæ, and after they have passed it through a sieve, drink it. It is much like diluted honey, though somewhat sweeter."

In Italy, especially in Calabria, during periods of excessive heat, drops of a honey-like substance fall to the ground, and are called by the inhabitants *manna*. This substance, of a sweetish glutinous flavour, suddenly appearing on the leaves of plants, was asserted to stop their growth and act injuriously on the plants. Such leaves were spoken of as "Foglie ammanate" (leaves affected by manna). They used a similar term of grapes which have acquired a peculiar flavour when covered with the same substance as "Vino ammanato."

He would take next the vegetable productions described as *Manna.* On this latter subject there were many writers, but one of them, Buckhardt, in "Notes on the Bedouins and Waliabys," when speaking of Wady-el-Shiekh, to the north of Mt. Serbel, says, "In many parts it was thickly overgrown with the tamarisk or *tarfa.* It is from this *tarfa* that the manna is obtained; and it is very strange that the fact should have remained unknown in Europe till M. Seetzin mentioned it in a brief notice of his tour to Sinai, published in the *Mines de l'Orient.* This substance is called by the Arabs *Mann*, and accurately resembles the description of the Manna given in Scripture. In the month of June it drops from the thorns of the tamarisk upon the fallen twigs, leaves, and thorns, which always cover the ground beneath the tree in the natural state; the Manna is collected before sunrise, when it is coagulated, but it dissolves as soon as the sun shines upon it. The Arabs clear away the leaves, dirt, &c., which adhere to it, boil it, strain it through a coarse piece of cloth, and put it into leathern skins; in this way they preserve it till the following year, and use it, as they do honey, to pour over their unleavened bread, or to dip their bread into. I could not learn that they ever made it into cakes or loaves. The Manna is found only in years when copious rains have fallen; sometimes it is not produced at all. I saw none of it among the Arabs, but I obtained a piece of last year's produce at the Convent, where, having been kept in the cool shade and moderate temperature of that place, it had become quite solid, and formed a small cake; it became soft when kept some time in the hand, if placed in the sun for five minutes; but when restored to a cool place it became solid again in a quarter of an hour. In the season at which the Arabs gather it, it never acquires that degree of hardness which allows of it being pounded, as the Israelites are said to have done (Numb. xi. 8.) The colour is dirty yellow, and the piece which I saw was still mixed with the tamarisk leaves; its taste is agreeable, somewhat aromatic, and as sweet as honey."

This *mann*, or manna, which was said to drop from the *Tamarix mannifera*, was said by some not to exude from the tree, but to be formed by an insect which abounded on the tamarisk. Others affirmed that an insect, a *coccus*, punctured the tree, that the juice exuded and dropped on the ground as described, and that the dissolving after sunrise was simply the evaporating of the fluid part of the exudation. There was another substance known by the name of manna, and commonly employed in medicine. This was merely a sweet condensed juice of certain plants, but especially obtained from an ash tree, *fraxinus rotundifolia*, a tree indigenous to Italy and the south of Europe, and found growing abundantly without culture in Calabria, where collecting manna was a regular trade, commenced about the end of July.

The gatherers of manna made a horizontal cut in the trunk of the tree, and on the following day a second cut was made, into which the point of a maple leaf was fixed, while the stalk part was placed in the first slit, thus forming a kind of cup to receive the exuding juice. Sometimes they applied thin straws to the incisions, or pieces of twig, on which the manna ran as it exuded, and so formed tubular pieces, which were called *Manna in Cannoli*, and fetched a higher price than that collected on leaves. The season for collecting manna was over by the end of August. At one time, manna from Syria was in request, but the Calabrian was thought better. In Mexico, a manna was obtained which seemed to take the place of cheese, while in other places a manna was eaten much in the same way as honey. There seemed to be some relationship between these so-called mannas and some of the sugars obtained by making incisions in the trunks of trees, notably in the case of sugar maple. It was a well-known fact that the juices of many trees and plants when made to exude, in a somewhat similar way, did on the evaporation of the watery particles produce substances akin to but differing from manna in their qualities and properties.

In the year 1849, Mr. Giles Munby read a paper before the British Association at Birmingham, on the "Botanical Productions of the Kingdom of Algiers," in which he called attention to a lichen, *L. Esculentus* or *Lecanoru esculenta*, as it was now named, which he considered agreed more nearly than any other substance hitherto discovered with the description of the manna on which the Israelites fed during their wanderings in the desert. He mentioned that this lichen, which was found on the sands of the desert, sprung up during the night much in the same way as mushrooms. That during an expedition to the south of Constantine, the French soldiers made bread of it and cooked it in various ways, actually subsisting on it for several days. In *Science Gossip* for 1872, at page 60, was given a description of this curious plant, specimens of which had been presented to the Museum by the gentleman, T. B. W., who furnished the material for that article and articles in subsequent numbers, 1872, p. 186; 1873, p. 118; and 1875, p. 146. From these it appeared Pallas figured and described this plant in 1776, and said "it occurs in the very driest limestone of the Tartarian desert, scarcely distinguishable from small stones. except by the expert."

The specimens before them were collected at Reboud Djelfa, in the desert of the Great Atlas Chain, and were about one-fifth the size of those figured by Pallas. Berkeley mentioned that, lying loose on the ground without any attachment, it was easily rolled along by the wind, and sometimes piled together in layers several inches thick, and that at times being carried up by whirlwinds, it was showered down on the ground. One such shower fell at Erzeroun during a time of great scarcity, and afforded very opportune relief to the inhabitants. Lindley, in his Vegetable Botany, speaking of *L. Esculentus*, says "it sometimes appears in immense quantities in Persia, Armenia, and Tartary, where they are devoured by the natives, who fancy that they must fall from heaven, not knowing how to account for the prodigious numbers of the plants, of the origin of which they are ignorant." Parrot says that "in some districts of Persia they cover the ground to the depth of five or six inches," and Eversman, who had an opportunity of studying it, was convinced that even in its earliest stages, the plant had not the slightest attachment to a grain of sand.

Another fact in connection with *L. Esculenta* and *L. Affinis* was, that, instead of being produced at uncertain intervals and only during a few months, it was produced during the whole year. It appeared from an article by Dr. Ruke, reprinted in the Pharmaceutical Journal for September, 1860, that *L. Esculenta* was presented to the Academy of Sciences in 1828. The lichen was described as being of a fawn colour, granulated, composed of broken crusts, which had fallen in the neighbourhood of Mount Ararat, and which a Russian General of the Persian army had given to M. Thénard, who presented it to the Academy. It seemed this lichen dried up during the summer in the mountains, and was transported by the winds to great distances; this led the inhabitants to say the grain had fallen from heaven. Such a shower fell in 1845, in the Crimea, and covered the ground to the depth of three or four inches, and was used as food by the inhabitants for several days.

Wherever this lichen occurred in any quantity men and cattle eat it. In Asia Minor also it sometimes formed beds several inches thick, on which not only the sheep were nourished, but a species of bread was made from it, and consumed by the poor, who regarded it as true manna sent from Heaven. There was one fact in connection with lichens generally, all contained nitrogeneous matters and starch, and many kinds were used as food.

It was often argued, and especially by a writer in the Dictionary of the Bible, that the manna of Scripture was wholly miraculous, and not in any respect a product of Nature. All the plants mentioned did produce the so-called manna for only a few months : but these lichens might be gathered all the year round. The lichens again were produced in large quantities, but not, as he states, at the rate of 15,000,000lbs. a week, which quantity might, by Divine agency, assuming a lichen to have been the manna of Scripture, have been produced by increasing the growth without depriving the plants of their character as natural products.

Another difficulty which had puzzled many was the fact that the manna collected on the sixth day "did not stink" on the Sabbath, though that collected on other days and kept over did ; but it seemed the injunction, "Bake that ye will bake *to-day*, and seethe that ye will seethe," showed how by the process of cooking decomposition was arrested. He could quite understand that this very lichen, gathered in large quantities while the dew was on it, and heaped up damp and moist, would decompose, ferment, and deteriorate. The fact that the Israelites were supplied with manna for forty years, that a double quantity fell on the sixth day, and that it ceased when their wandering ended, placed its production among the miracles of Divine agency without taking away from it the character of being a natural production, created only when first seen by the children of Israel, and no longer existing as a part of the scheme of the life of the globe.

Of all the substances hitherto assumed to be the manna of Scripture, this *L. Esculenta* seemed to approach the nearest, in its being produced all the year round, being round and hard, able to be pounded and converted into bread, appearing in large quantities, as if from Heaven, while all the others were found only at certain seasons, and did not in so many respects correspond with that described in Holy Writ.

The President, Mr. J. DENNANT, proposed a vote of thanks for the paper, and, in inviting discussion, said that neither religion nor politics were allowed to be discussed.

Mr. G. D. SAWYER said that though religion was not to be discussed, the Scriptures had been appealed to, and he should like to ask how, if they accepted the fact that the manna could not be found on the seventh day, they could still believe that it was a natural production. To his mind it was a convincing proof, if they accepted the fact that it was not found on the seventh day, that it was not a natural production.

Mr. WONFOR replied by asking Mr Sawyer if he ever went out to gather mushrooms, because if he had, he must have noticed, that where none could be found one morning, there would be abundance the next.

Mr. SAWYER : Every seventh day ?

Mr. WONFOR said he did not intend to lead to questions of that kind. It would be equally a miracle to produce a natural substance in more than its natural abundance, and for longer than its natural period, as to create an entirely new substance. In the chapter that contained the account of the manna, was also an account of that wonderful production of quails. That was one reason why, with all deference to the opinions of others, and with the most reverent feeling, he suggested the possibility of a substance already in existence being produced in double quantity.

Mr. G. D. SAWYER mentioned it with no feeling, but as in a scientific discussion. He could not take it to be a natural substance if it could not be found.

Mr. WONFOR : It was only recorded that they went out one Sabbath day and could not find it. It did not say that they ever went out again and could not find it.

Mr. C. F. DENNET expressed the great pleasure he had felt in listening to the paper, especially after the proceedings of the week at the Social Science Congress. It was an agreeable purging of their minds of the intellectual stuff that had been crammed into their mouths; and he felt specially delighted, and thanked Mr. Wonfor for the information he had afforded on the subject.

Mr. DOWSETT pointed out that the manna previously found could not have been the manna eaten by the children of Israel, inasmuch as it was not nutritious; and was also slightly purgative.

NOVEMBER 4TH.

ORDINARY MEETING.—DR. HALLIFAX ON "THE NERVOUS SYSTEM."

In introducing to the Members for their discussion "The Nervous System and its Functions," he would remark that, although the subject might appear almost a professional one, it was, to his mind, one which was of great importance to every student of scientific matters.

The knowledge of early physiologists had been very vague and indefinite with regard to the nervous system, and it had only been within the last hundred years that any great advancement had been made on the general observations of those who had in earlier ages bestowed their attention to the system of nerves with which all the members of the animal kingdom were endowed, or that the knowledge that had been gained had been placed before the public in the manner which it merited.

To Dr. Bell, among others, who had thrown much light on the functions of the nerves, the greatest praise must be bestowed. But, though he and other physiologists who had since devoted their time and talents to the study of this particular branch of physiology had laid such great results before the scientific students of modern times, there were yet many problems to be solved, and much to interest the general observer. The nerves which proceeded from the cerebro-spinal axis, as it was named, in all the higher forms of animals formed the wonderful apparatus which by a rare development presented us with the glorious phenomena of the great minds of a Shakespeare, a Bacon, or a Newton.

The spine was the seat of the motive power of the many passions which we possessed, some good enough to obtain the approval of Heaven, and others bad enough to have their origin in "another place." These passions, impulses, and emotions were all put in motion and guided by the action of the nerve trunk, which consisted of a number of fibres running parallel with each other and the *ganglia*, or knots which the fibres and nerve cells formed at particular points in the cerebro-spinal axis. These *ganglia* were united in one superior *ganglion*, which in the higher animals was situated immediately beneath the brain, which surmounted it. The nerve cells were called globular, but, as a matter of fact, the prolongations proceeding from them made the form stellate.

The *ganglia* were connected with each vertebra by two distinct and separate fibres, one of which was named the sentient and the other the motive nerve. These had two separate, although similar, functions, and in many respects bore an analogy to the phenomena presented by the electric telegraph. As in the telegraph, two wires were required for the efficient performance of the work, so two fibres were required to sustain the nervous force in its integrity. And as the telegraphic apparatus required stimulating by a relay of electric batteries, so was the amount of nervous energy supplemented by the *ganglia* or knots which occurred at intervals throughout the system.

The simpler the animal in construction, the more simple the nervous system. For instance, in the case of the ascidians a single *ganglion* only was required to perform the offices required, and this single *ganglion* was typical of the more elaborate nervous system of the higher animals.

The motions produced by these nerves were quite involuntary, and must in their consideration be kept quite distinct from the actions in which the will was brought to bear; the ejection of matter from the interior of one of the ascidians being precisely the same as the ejection of a crumb or other foreign matter from the throat of a human being, for the latter could not help the violent action which naturally took place to free the body from the pain and danger attending the lodgment of such foreign matter in the throat.

In the case of the articulata, the number of *ganglia* corresponded with that of the articulations, so that each segment of an insect was provided with its own *ganglion*. In the higher animals the *ganglia* were united at the base of the brain, and thus the whole of the nervous system was placed in direct connection and communion with the seat of the intellectual and mental powers.

At the **President's** suggestion, Dr. **Hallifax** consented to continue the subject at the next ordinary meeting.

November 25th.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON "POLYCYSTINA."

Almost every microscopist possessed a slide or slides marked "Barbadoes Earth," or "Polycystina," and many only regarded them as beautiful and exquisite objects, without, possibly, considering what they were or what the nature of the organism, whether animal or vegetable, which originated these beautiful crystal-like forms of almost every conceivable shape.

If we turned to the manuals on the microscope, we found that they were the minute siliceous shells of a class of animals, whose living part or substance consisted of a brownish coloured "sarcode," somewhat resembling that met with in the protean animal, the amœba, "a little particle," as it had been said, "of apparently homogeneous jelly, changing itself into a greater variety of forms than the fabled Proteus, laying hold of its food without members, swallowing it without a mouth, digesting it without a stomach, appropriating its nutritious material without absorbent vessels or a circulating system, feeling (if it has any power to do so) without nerves; and not only this, but in many instances forming shelly coverings of a symmetry and complexity not surpassed by those of any testaceous animals."

That was actually what the Polycystina accomplished, being mere lumps of *sarcode.* They spun, or wove, or, at least, formed for themselves coverings resembling the most costly and delicate filigree-work, rivalling in beauty Chinese carvings in ivory, or ancient Peruvian or modern Indian or Maltese silver filigree, out of a substance less workable or ductile, but infinitely more beautiful, than ivory or silver—

namely, silex, extracted, in some way at present unexplained, either from their food or the element in which they lived—the sea. These exquisite habitations were perforated to allow for the extrusion of the pseudo-podia, as they were called, to be sent out in all directions to collect whatever was needed for nutriment or continuing the building up of their habitations.

They were not confined, as was once thought, to fossil forms and periods, but were to be dredged up living in the Mediterranean, the North Sea—notably off Cuxhaven—the Pacific, and the Atlantic; yet, though the greatest care had been used in drawing them up through the water, the mere friction or pressure generally caused the pseudo-podia to shrink and collapse. According to Dr. Carpenter, the *sarcode* substance did not always fill the shell, often occupying only the upper part, and showed a tendency to a regular division into four lobes. Some of the shells were spheres with smaller spheres like Chinese balls within them; these spheres were often connected by radiating rods, sometimes prolonged into very delicate spines. Some of the globes had lesser globes attached to them, with ovoid or conical prolongations; others were star-shaped, with the spaces between the rays filled in with a most beautiful network.

Although they were almost as widely distributed and quite as varied in their form as the foraminifera, yet they must in past times geologically have been more numerous, as we found whole rocks composed of their shells, mingled with the siliceous valves of diatoms; thus the chalks and marls of Sicily, Greece, and Oran, in Africa, and the diatomaceous deposits, many feet thick, in Bermuda and Richmond (Virginia), contained them in great variety; but the great source of our supply was from Cambridge and Chimborazo, in the island of Barbadoes, where immense masses of a chalk-like rock were found, composed almost entirely of the siliceous shells of Polycystina. A supply of this rock containing most lovely forms, had been sent by their kind friend and member, Mr. T. Curties, of Holborn, for distribution that evening, and he had also sent a couple of slides prepared by Topping and Cole, from the same deposit, with a hope that some of the members might be incited to emulation, and produce slides as good.

Those who wished to prepare the material would find an account how best to manipulate it by Mr. Furlong, in the first volume of the "Miscroscopical Society's Transactions" (new series), or in " Davis on Microscopic mountings and preparation." They should be mounted dry, or in balsam, and viewed as opaque or transparent objects, and with the spot lens or paraboloid. There was a method of giving them an enamel-like opacity by burning them on platinum foil, but whatever method of mounting or illumination was adopted, all who had seen the Polycystina under the microscope must allow they were very beautiful and delicately sculptured objects, while the question how the creatures whose shells they were, constructed such charming habitations, remained among the, at present, unsolved problems of Natural History.

The Meeting then became a Conversazione, when some exquisite and beautiful specimens of Polycystina were exhibited under the microscope.

DECEMBER 9th.

ORDINARY MEETING.—DR. HALLIFAX ON "THE NERVOUS SYSTEM AND ITS FUNCTIONS."

(Continuation).

Dr. **HALLIFAX** said, at the last meeting he endeavoured to trace the different gradations of the nervous system, as they appeared throughout the series of animals, beginning at the lowest; and his object was to show that, as they ascended, the complexity of the nervous system kept pace with the complexity of the animal organization, and was not only developed on the introduction of a new organ, but even on the exaltation of an organ already existing. The insect tribes approached nearer than any other of the series to the mammalian; and, by way of illustration, he would select one of the social insects, a bee or a wasp, as denoting in its action the exercise of an intelligent principle. In the higher forms of insects was found the cerebro-spinal axis, the great central organ, consisting of the spinal cord and the cerebrum. In man the cord was of great length, proceeding from the cerebrum down to the lower portion of the frame, sending off, on each side, throughout the system, thirty-one pairs of spinal nerves. Each two of these nerves were contained in one sheath, although fulfilling entirely different functions; one at the posterior ministering to the purposes of sensation, and the other, at the anterior, ministering in response to the contraction of the corresponding muscles.

Next, they approached that important doctrine which was called the "excito-motor"—the sensory nerve conveying the impression from without to the ganglionic matter, which impression was responded to by a mysterious action in the motor, or those nerves the filaments of which supplied the muscular system that holds throughout. If they examined the ventral cord of the higher insects,—so called from being found in the ventral region,—two cords could be distinctly traced; and these were knotted into ganglionic little cells. Going on to the thorax of insects, to which were fixed the legs and wings, they all knew the remarkable activity of those limbs,—they found the ganglia aggregating together to provide due energy for them. Advancing to the cephalic ganglion, there was a still further enlargement and evolution of this nervous matter, it being the neighbourhood of that wonderful organ, the insect's eye. It was under the guidance of visual impressions that almost all the movements of insects were performed and controlled, and thus they would observe how the proportion was kept up between the ganglionic centre and the organ it supplied.

With regard to this double cord in the insects, it was remarkable that, in the embryonic stage of the human form, the spinal cord had also two distinct lines, so that, in the former, they had an element of what was the commencement of the human spinal cord; while the sensorium of the human brain corresponded with the cephalic ganglion of the insect. In insects, the reflex action was automatic, all the operations going on by virtue of the creature's structure, without the interposition of an intelligent principle, the majority of the actions of the social insects being thus explained.

It was the same in the human brain; but here they had the superadded organ, the cerebrum, the material instrument of thought and will; and the degree of intelligence and self control corresponded to the degree of development of that organ. It consisted of the medullary matter, which was invested on its outer surface with a layer of ganglionic cells, called cineritious, the medullary matter itself being composed merely of nerve fibres, connected with the cortical substance and the sensorium. From the sensorium radiated fibres going to the convolutions of the brain, these fibres being in two sets; one carrying an impression upwards to the cortical substance, the force returning by the other to the motor part of the sensorium. The cineritious layer was made up of vascular members by which the great part of the circulating fluid was conveyed to the cortical substance, and the whole action of the brain was dependent upon that supply.

As showing the importance of this, it might be mentioned, it had been established that, although the brain was estimated at a 45th part, by weight, of the entire body, these arteries, conveying blood to the cranium for the purposes of the brain, were actually one-fifth of the whole circulating mass; and although there were four principal vessels conveying arterial blood into the cranium, encircling it and branching off to supply the whole external surface of the brain, they were so powerful that one was sufficient to keep up the circulation in a subdued degree.

With regard to the cerebellum, it was little understood; but the theory had been propounded that it controlled the reproductive system. The whole brain was divided into two hemispheres, united by a band, in order to give them a harmonious co-operation; and it was a curious fact that, in some instances, where this connection was greatly deficient, the person lacked foresight, and was utterly unable to act upon experience. Before resuming his seat, Dr. Hallifax said the subject he had endeavoured to deal with was a great and complex one. He had given a brief outline of what he had thought worthy their consideration, and he recommended those who sought further information to study Dr. Carpenter's book on "Mental Physiology."

The President, Mr. J. DENNANT, conveyed the best thanks of the meeting to Dr. Hallifax for his interesting lecture, remarking that no Member of the Society was so competent to deal with the physiology of the nervous system as the eminent doctor who had addressed them.

A discussion followed, in which the ex-President, Alderman COX, Mr. J. E. HASELWOOD, Mr. WONFOR, the PRESIDENT, and Mr. DENNET took part. The interest of it centred in the automatic action or otherwise of the nervous system, as laid down by Dr. Hallifax, and opinions varied on the point; Alderman Cox holding that the different functions developed a certain mental activity which produced a certain effect on the muscles; while the President expressed his opinion that problems were often worked out by the brain automatically and without any mental exertion.

JANUARY 13th.

ORDINARY MEETING.—MR. C. P. SMITH ON "BEES."

The bee was an insect consisting of a head, thorax, and abdomen, united by cylinders which were at times so reduced as to make it wonderful how the minute nervous cord passing through it was able to control all the functions of the organs of sensation and motion. The head was the most important section, and carried the antennæ, the compound eyes, the simple eyes, and the organs of the mouth. The antennæ, or feelers, were variously constructed, being sometimes straight and at other times curved, or like a string of beads. In a wild bee the integument of the antennæ was of a hexagonal structure. The antennæ had been supposed to be organs of smell and also of hearing, but this was by no means certain; they were, however, in constant motion, and were frequently protruded into a flower before the insect entered, for the purpose, apparently, of ascertaining its fitness. The fact of a special apparatus for the purpose of cleaning them would also show that Nature had attached great importance to them. On each side of the head were the large compound eyes which varied in the various genera, and consisted of a number of small hexagonal facets, each one having its own branch of the optic nerve. The use of these compound eyes was supposed to be the examination of near objects. On the crown of the head were the three stemata, or simple eyes, which were supposed to be used for long vision, as when covered up by a black varnish Réaumur found that the bee invariably flew straight up, and was lost. The organs of the mouth, called trophi, were very variable in development in the different genera, and, when complete, consist of a labrum, or upper lip, a epipharynx, or gullet, which formed the mouth, the labrum, or lower lip, and an organ called the tongue. Besides these single organs the organs in pairs were the mandibles, the maxillæ, maxillary palpi, the labial palpi, and the paraglossæ. The labrum was of a horny or leathery consistence, and closed over the organs below it, being covered when at rest by the mandibles. The gullet was placed close under the labrum, and was closed by the valve above, beneath which was a small triangular appendage, which received the honey or food. The labrum had two joints, one of which carried the maxillæ, or lower jaws, which in a state of rest folded together and formed a sheath for the lingual apparatus. The tongue was not, as was formerly thought, tubular, but flat, and when at repose was broader than thick. It could be lengthened and shortened with great rapidity, thus pushing the syrup up to the gullet. Réaumur proved that the food always passes over the surface of the tongue, and not through the aperture which was thought to exist in it. The thorax was divided into three parts, to the front of which the front legs were attached. On the tibia of the fore-legs in all bees was a velum, so named from its resemblance to a little sail, opposite which, at the base of the palmæ, was a deep incision called the strigilis or currycomb, from the pecten or comb of short stiff hair which fringed it. This apparatus was for the purpose of cleaning the antennæ, which were drawn through the hollow incision while being pressed by the velum against the currycomb. In the boring bees the mandibles do the cutting and excavating work, while the forelegs or hands were used to clear away the rubbish thus formed; but by the artizan bee the forelegs were used like trowels to work up the soft clay into cells. The bee had the power of locking the wings together in flight by means of a row of hooks on the inferior wing which caught in a ridge or ledge in the upper wing, and thus gave the insect a much greater power of beating the air. On the hinder portion of the thorax were placed the hind legs, the shank of which in the social bee was dilated, for the purpose of carrying pollen. The abdomen was often elegantly coloured, and consisted of six imbricated segments in the female and seven in the male. In the artizan bee pollen was conveyed on the abdomen instead of the hind legs, perhaps because of the narrow entrances to their nests.

Passing on to the consideration of the honey bee, in particular, they found the male or drone was distinguished by its more cylindrical shape, its larger size, and by being more densely hairy all over. The large compound eyes met at the top of the head and covered all the side of the face. The abdomen consisted of seven segments, being thus distinguished from the queen, which had six segments. The structure of the drone, as of all male bees, incapacitated him from any share in the work of the hive. So far as had been ascertained its sole use was to impregnate the young queens, and to accomplish this end, Nature had been lavish in the production of drones, about 1000 being produced in each hive during a summer, although, as seldom more than two swarms departed, but three drones were required for that purpose. The large eyes of the drone no doubt assisted him in finding the queen during her nuptial flight, while the greater sweep of the hinder wings enabled him to rise above her. The large number of drones was no doubt required by the circumstance of fertilization taking place high up in the air, and by the great importance of a speedy return of the queen to the hive, as in the air she was in great fear of being snapped up by birds, and thus in some cases the entire hive must perish. The fact of the drones not adding to but diminishing the honey had induced bee keepers as long ago as Aristotle to use traps for their exclusion and destruction. The working bees, however, in the latter end of July, suddenly made up their minds to stop the consumption of honey by driving out the drones and preventing their return, so that they perished from want. At the same time, the workers dragged out and stung to death all drone grubs, being apparently filled with the utmost fury. During a wet summer, when honey could not be obtained, the drones were driven out earlier. The queen bee was the mother of the hive, and was easily distinguished from the other bees by her size, being much longer and the abdomen being much more spindle-shaped. Her chief function was to lay eggs ; and this she did both day and night. The manner in which the eggs were fertilized was a great mystery, until Dzierzon showed that there was communicating with the oviduct, through which the eggs passed, a spermatic reservoir. The fertilization of the queen took place on the wing, and it appeared probable that it only took place once in life. Two or three days after impregnation she began to lay ; and if not permitted to leave the hive she lay all the same, though she only produced drones. This had been proved by Siebold who kept some virgin queens caged and found they produced drones only. From observations and experiments it seemed probable that the queen only laid two kinds of eggs, viz. : worker and drone, the former being capable by appropriate feeding and management of being developed into queens. The queen only laid eggs, leaving the workers to look after them and attend to the young. The other peculiarities of the queen were the want of a honey bag, the inability to secret wax, the convex thigh which prevented the gathering of pollen, and the blunt sting that could not pierce the human hand. It was, therefore, dependent on the workers for food, which was continually presented to her by attendants who, like true courtiers, never turned their backs on her. The neuter, or worker, was principally distinguished by its pollen-collecting apparatus. Though called a neuter, it was in reality an undeveloped female, and occasionally laid eggs, as previously noticed. Perhaps the most important organ of the worker was the marvellously complicated muscular tongue with which the honey of flowers was not sucked, but lapped up, and passed along the grooved surface to the mouth, and then to the honey bag. The tongue of the hive-bee was twice folded in repose. The honey was collected from a great number of flowers, of which the lime, heather, and white clover, were perhaps the principal. The proboscis of the hive-bee was not long enough to reach the nectary of the red clover, which was visited by the humble-bee. As a great deal of honey was needed to make wax for forming the comb, means had been adopted to empty the combs and return them to the hive. Combs were built most rapidly at night, the bees working during the day at honey collecting. The peculiar structure of the working bee could not but be admired in conjunction with its work of cell building. Their mandibles were endentate and like spoons, and were so used for strengthening and plastering their work, while the brushes on the posterior feet and the little auricle enabled the hind legs to gather up the wax as it was formed, and pass it on to the mouth to be masticated and moulded by the mandibles. The want of spurs on the hind legs (in which the hive-bee differed from the humble-bee), gave a greater freedom and play to the comb of short stiff bristles at the extreme edge of the shank. Propolis, an adhesive substance, gathered from the buds of poplar, hollyhock, willow, and other trees, was gathered and used to strengthen the defences of the hive. Propolis was with difficulty kneaded into a ball and brought home in the corbiculæ, but it dried so quickly that it was sometimes with difficulty torn by the bees from the legs of the collector. This substance was indispensable for filling up cracks and cementing the hive to its floor boards, which was always done for the sake of keeping out intruders. The eggs of the bee were of a long oval shape, and being covered with a glutinous matter stuck to the bottom of the cell. In three or four days they hatched a little white worm which had fifteen segments, each, except the head and four terminal ones, supplied with a pair of spiracles. It had no feet, but small knobs existed on each side of the segments, giving it a slight power of motion. This grub was very voracious, and was sedulously supplied with food by its nurses. On this food it throve until in four days it was fully grown and filled the cell. The worker then sealed over the cell, and the grub spun a cocoon of silk in which it grew to maturity, which is in twenty-one days. It then burst the covering of the cell and flew out. The cells for the queens were four or five in number, and they hung with their mouths downward. They were four times as large as the others, and much stronger. The queen grubs were so largely supplied with food, that they were in a thick bed of jelly, some of which usually remained after hatching. They arrived at maturity one-third earlier than the others, in consequence of the difference of their food, which also prolonged the life of the queen to two or three years instead of a few months. The young queen was jealously guarded by the workers from the queen mother, and at its nuptial flight the old queen generally left with other bees, who gorged themselves with honey before departing to seek a new hive.

MR. H. GOSS asked if a difference in the temperature of the cell of the queen bee had anything to do with the development of a worker into a queen.

MR. C. P. SMITH did not think it to be the case, and in answer to further questions from MR. GOSS, he said he did not know that the vertical position of the cell had anything to do with it; or if the food given to the queen was different to that given to the workers.

MR. GOSS said he had seen it stated that a queen laid from 70,000 to 80,000 eggs.

MR. SMITH added that a bee only lived seven or eight weeks during the summer.

DR. INGLE called attention to the shape of the cells, and said it had been a mathematical problem as to whether the equilateral triangle, the hexagonal, or the square shape would waste the least space, and it had been found that the bee adopted *the* one—the hexagonal.

The Death of Mr. Hennah.

The **Chairman** said it was a painful duty for him to bring before their notice the death of Mr. Thomas Hennah, one of the Vice-Presidents. Those who had been members of the Society for some years would realise the real loss that had fallen upon them. He had ably sustained the office of President, was at all times a wise counsellor, and certainly exhibited a mind of no ordinary culture. He did not think he would be wrong if he said that Mr. Hennah was one of their best microscopists. He was kind and genial in his manner, willing at all times to impart to younger members the knowledge which they sought. He had made himself so completely a helper in the work of the Society that his loss would be felt by all. There were very few to take the places of those friends they had lost lately, and he hoped that when their loss was made known to the public, men of scientific attainments would consider it their duty to think of the Society. In conclusion, the Chairman moved the following resolution :—

"The Brighton and Sussex Natural History Society, deeply lamenting the loss it has sustained in the death of Mr. T. H. Hennah, desires to convey to Mrs. Hennah and her family a sincere expression of sympathy with them in their sad bereavement, and to express a hope that it may be some solace to them to know that her late husband was held in the highest esteem and respect by his co-workers in the Society, who cannot fail to miss in no ordinary way a Member of such conspicuous ability and genial character."

The funeral would take place on the following day. He regretted that his health would not permit him to be present, but he hoped that as many Members as could would be present to show their respect to their old friend.

Mr. **Wonfor** seconded the resolution, as a personal friend of Mr. Hennah and his family for more than eighteen years. During the time he had known them he had always found Mr. Hennah a man of great kindness and courtesy. His death to him was a great shock ; and he felt that in losing him they had lost a great support to the Society. It was he who established the microscopical meetings which had proved so interesting ; and not only had he done this, but, while his health would permit it, he helped to keep up a microscopical club. Not only was his death a great loss to this Society, but also to the town at large. There was scarcely a gentleman in the town who worked with his microscope but was indebted for advice, assistance, and instruction to Mr. Hennah, who had been always willing and ready, even though suffering from physical debility, to give information to the mere tyro equally with the advanced student. All who came in contact with him could bear witness to his affable and gentlemanly bearing, and the genial way in which he conveyed information to others.

JANUARY 27TH.

MICROSCOPICAL MEETING.—"THE ANATOMY OF THE BEE," IN ILLUSTRATION OF MR. C. P. SMITH'S PAPER ON THE BEE, READ AT THE JANUARY ORDINARY MEETING.

The **PRESIDENT** (Mr. J. Dennant) said there was no paper to be read, as Mr. Smith's paper at the last meeting had almost exhausted the subject, but as there was neither time noropportunity on that occasion to examine the several parts of the bee described by Mr. Smith, an opportunity would be afforded them that evening of so doing. He believed Mr. Smith and other gentlemen had brought down a number of objects of a very interesting character.

MR. T. W. WONFOR remarked that he had since the last meeting examined the curious bodies in the specimen of American honey shown by Mr. C. F. Dennet, and found they were crystals of honey sugar. It would be seen by comparing them with crystals of cane sugar how much they differed from it in their mode of crystallization. He found also plenty of pollen grains in the honey, but whether they were of the orange, on the flowers of which the bees were said to feed, he had not had the opportunity of verifying. He had also examined the *Isoetes* exhibited at the last meeting, and had found both macrospores and microspores.

MR. C. P. SMITH, in reply to the President, said he had brought down for exhibition the general anatomy of the hive bee, mounted on one slide, the ovaries of the queen bee, a very uncommon object, in which the eggs were shown, as well as the sting, the tongues of the hive and other bees, and the sting of wasp.

MR. WONFOR said he had the tongues of the humble bee, the honey bee, and the wasp for comparison, the stings of the wasp and bee, the latter showing the two serrated stings protruded from the sheath, the heads of the hive bee and wasp, parasites of bee, and crystals of honey and sugar.

The meeting then became a conversazione, when the abovementioned and other objects illustrating the anatomy of the bee were exhibited by the President, Messrs. Haselwood, C. P. Smith, E. Glaisyer, R. Glaisyer, and Wonfor.

FEBRUARY 10TH.

ORDINARY MEETING.—MR. BENJAMIN LOMAX "ON THE BRANCHING OF TREES."

The subject of the paper had always possessed the greatest interest for him, principally, he thought, because he seemed to have it all to himself. Until the time of Lindley, physiologists appeared to look upon a tree as a structure composed entirely of a root and flowers, and though Le Maout, Sachs, and others had lately bestowed much attention on Taxophylly, the growth of wood, and the development of branches from buds, that symmetrical arrangement by which each tree acquired its marked and unmistakeable character and outline, preserved to the finest veining of its leaves, had been entirely neglected by the botanists, and only remarked on, from an artistic point of view, by Ruskin, in his "Modern Painters."

That the form of a tree was regulated by general laws, independent of its minute structure, would seem probable to every naturalist; and the Society would be prepared to look with favour upon an explanation which referred it to the composition of two combining or opposing forces, as in Mechanics and Electricity, even though the way should not seem clear for pointing out the exact nature of the forces themselves. Such an explanation he had to submit. It would account for every peculiarity in the form of branches and leaves, considered as such, but it was so entirely independent of the well-known laws which regulated the formation of wood rings, &c., that it seemed impossible at present to harmonise the two. If his position were true, they would ultimately be harmonised. If false, the facts at least were worthy of notice; in any case he claimed for his scheme the consideration due to lengthened investigations under very favourable circumstances. For fifteen years he had bestowed pretty constant attention to this subject. He had made some hundreds of measurements in England, Australia, and Peru, on trees of all sizes, from the lilac and alder to the Eucalypti. For this purpose, he had used, successively, a lady's measuring tape, a surveyor's chain, and a theodolite or sextant, and on one occasion had allowed himself to be hoisted 120 feet in the air by a rope drawn over with the help of a bow and arrow, but never had he found a single instance of departure from the principles described.

It was not at every period of a tree's life that it possessed a perfect form. During what might be called its childhood the branches were not yet visible; in its advanced maturity the true branches were intermixed with subsidiary limbs, forming no part of the original plan, and produced by the development of what would have been mere twigs but for accidents to which he should hereafter refer; while old age showed us a confused and tangled mass of branches, broken and repaired, or bent in distorted forms to avoid collision with others, or to take advantage of some accidental condition. But there was a time in a tree's history which might be likened to our own useful prime, when the graceful structure presented neither the bareness of the sapling nor the unintelligible luxuriance of the maturer growth, and when the laws to which he had referred might be easily recognised and fully traced. He had spoken of branches as normal and subsidiary or accidental, and it was necessary that he should justify such a distinction. By way of doing so, he would ask those who had seen trees cut or split longitudinally to try and recall the appearance of the trunk or larger limbs at the point where a branch left them. He had had much to do with sawmills, and had seen many such sections cut, and often one tree, falling beneath his axe, had lighted in the fork of another and split it to the ground. The appearance then presented was that presented by the forked twig which a schoolboy split to make his bird trap.

The wood from bark to bark formed one continued strip of white, from which the white wood of the branch turned off without mark of junction, just as rivers were indicated in a map. These are normal branches. Sometimes, however, a very different appearance presented itself—a branch was apparently *inserted* into the trunk, penetrating only through the outer rings, and surrounded by a kind of socket. Such limbs had commenced their growth after the branches above them, and, though produced late in life, had outstripped their predecessors, partly because nearer the roots, and partly because they had been deriving their nourishment from the outer and softer layers of the cambium region, where alone the sap descended in any considerable quantity. It was only of the normal limbs that he should speak for the present.

A well formed tree, then, consisted of a trunk or trunks, ascending to a certain distance and there throwing off one or more limbs. These limbs might be large or small in comparison with the parent stem, might be opposite or slightly separated, and might turn off at any angle not exceeding 90°. Where the limb turned off the stem was deflected in the opposite direction. That deflection might be very slight, but it could always be traced and sometimes was so great as to render it impossible to tell which of the two or more divisions was to be regarded as the continuation of the parent stem. The original pattern thus given was afterwards adhered to, and throughout the whole structure each branch with its branchlets repeated the same form of subdivision, so that it might be traced to the minutest ramifications, and could be seen in the skeleton of the leaves. If, then, we rightly understood one forking, we understood all, and he proposed to consider one minutely. There were several points requiring attention, which might be enumerated as follows :—

1. The size of the limb (*i.e.*, its sectional area).
2. The size of the stem above the joint.
3. The angle at which the limb branches off.
4. The amount of deflection in the stem.
5. The relative length of the previous and succeeding internodes.

If his view were correct, all these were connected together by one common law, so that if one element were given the rest could be deduced. The required data were the amounts and proportion of two forces whose nature he did not yet attempt to define, the one tending to lengthen the stem and its offshoots, the other tending to separate the wood fibres laterally, the two energies holding much the same relation to each other as the centrifugal force and that of gravity did to each other in the planetary system. If the first force predominated, the tree would be tall and narrow; if the latter, it would be wide-spreading. The ratio of the two gave a constant fraction, which might be called the "co-efficient of ramification," and from which the whole outline of the tree might perhaps be calculated, just as a curve might be traced from its equation.

The size of the first limb was doubtless determined by some inherent law, as trees of the same species showed a striking uniformity in this respect, but he was not able even to imagine its nature. He knew, however, that the proportion of the limb to the stem once fixed was preserved throughout, and that every shoot bore the same proportion to its parent as the first branch to the primitive stem. The size of the barrel above the limb was far easier of determination. Its sectional area, added to that of the limb, always gave the sectional area of the trunk from which they sprung, and this was equally true where the division was into three or more branches. Thus, if from a trunk 37in. in circumference two limbs, measuring respectively 18in. and 12in. round, forked off, the resulting stem would measure 30in. in circumference, whether the two branches were at one point or separate, or, in other words, the sum of the squares of 18, 12, and 30 equalled the square of 37, nearly. This law, which held good, without exception, in every tree and every twig, settled a most important question, showing us that limbs were not off-shoots or lateral growths, but actual divisions of the stem from which they sprung; and this being so, we were led to infer that the whole of the leaf stalks on a tree, if united in one bundle, would make up the thickness of the main trunk, a conclusion as startling as it was inevitable.

This result might be illustrated by binding together, say, a hundred twigs, afterwards dividing them into ten, and these successively into fives, twos, and ones. The effect would be, that a fair model of a tree would be produced, in which the ultimate divisions evidently made up the bulk of the parent stem. If such a bundle were cut across, a very different spectacle was produced from that seen in the cross section of a forest tree. In the latter we saw a series of concentric rings traversed by radiating lines, known as "medullary rays;" in the former, a collection of circles, which, under extreme compression, might assume the hexagonal form. But this dissimilarity vanished on closer inspection and a more careful consideration of the manner in which trees grow. If we surrounded one twig by a circle of others, and subjected the whole to uniform pressure, we should find that the outer twigs, if sufficiently compressible, would form one continued ring, wherein each separate piece had the wedge-form produced by intersecting radii. Ring after ring might be thus formed, and the whole section of an aged tree satisfactorily imitated.

It would be noticed that in the fancied model each medullary wedge was connected with one twig and one only; and it might be asked whether he considered such to be the order of actual tree-growth? To this he answered that his illustration was but an illustration, and was intended to prove nothing; but the supposition was quite possible, though he knew nothing whatever concerning its truth. The angle of ramification was very uniform in trees of the same species, and was readily explained on the principle to which he wished to draw their attention.

Every student of dynamics knew that if two forces acting on or from one point be graphically represented by two lines of equivalent length and direction, the diagonal of the parallelogram so indicated would give the length and direction of their resultant, and *vice versâ.* So if we knew the longitudinal and lateral forces at any given fork, we should be able to trace the angle at which each division would leave the point of separation. As these data were not forthcoming, another means of investigation must be found. It was manifest that a force tending to separate any pair of fibres must vary in total amount directly as the number of fibres present; and as these together made up a limb, it followed that the amount of pressure tending to cause any two limbs to diverge from the original direction would be in direct proportion to the sectional area ot the limbs themselves. On the other hand, there was *primâ facie* reason to suppose that which he hoped to establish by another line of reasoning: that the tendency to longitudinal extension was at its greatest at the commencement, and decreased according to the amount of work done, or according to the distance from the root. On such a supposition we readily deduced a result which agreed exactly with observed fact, namely, that when two branches of equal size separated, they would have exactly the same angle of divergence; that where one exceeded the other, the larger would be nearer to, and the smaller farther from, the line of original direction; and that where the limb was very small in comparison with the stem, as in some of our coniferæ, the angle of ramification would be indefinitely near to a right angle, and the stem practically perpendicular.

They next came to the question of internodes; and here they might with profit refer to the herbaceous plants, which for the most part diminished them with great regularity, but in addition suppressed them altogether when any large draught was made on the vital reserve. Thus we found the lower leaves alternate, the higher opposite, and those surrounding the ovary verticillate. Such a rule obtained in forest trees; the internodes ordinarily decreasing so regularly that the proportion between the length and thickness of any internode was that of any other in the same tree; but this regularity disappeared, and whole internodes were suppressed where any abnormal necessity required the tree, for the preservation of its balance, to push out extra branches, or extend branches beyond their intended length. Without wearying by details that had been very pleasant to him, he might say that he had never seen a case of ramification which could not be explained on the assumption of two combining forces, and he did not expect to find one.

Between this humble attempt and the time when each tree should have its equation, whence its outline and taxophylly might be predicated, there was a great gulf fixed. If ever such a supposition could be reconciled with the annual succession of rings, it must be by the application of laws not yet enunciated, and many generations might pass before the connection could be held possible, but till that connection were established, the likeness of ramification to the most familiar effects of mechanical composition must be held as one of the most remarkable coincidences in Nature.

He would, in conclusion, remark that any gentleman wishing to pursue the same line of observation must prepare himself for difficulties. The effect of gravity, the reflection of heat from walls and banks, the presence of water in hot climates, and the alternate loss and recovery of balance, supplied a series of complications which must be patiently eliminated before the true law of ramification could be traced; but if any one, after such reasonable deductions, should fail to find everywhere the same unvarying proportions mentioned, he must have an experience widely differing from his own.

The PRESIDENT (Mr. J. Dennant), on behalf of those present, heartily thanked Mr. Lomax for his paper, short, but interesting and valuable, being original.

The discussion on the paper was opened by Mr. WONFOR pointing out that the subject had been treated from such a novel aspect, that difficulty would be experienced in discussing it, and thanking Mr. Lomax for suggesting ideas which might be considered in the coming spring.

Mr. G. D. SAWYER and Mr. HASELWOOD followed, the latter observing that there was a strong tendency to account for biological facts by mechanical laws. This was not new to them—they had that theory promulgated before, though not in so practical a form as that night. But he understood that the gentleman who asserted mechanical laws as an explanation of biological facts went further than Mr. Lomax had gone, and, therefore, he advised those present to be cautious in adopting mechanical laws as accounting for those things, as such an adoption might carry them further than the application of those laws to mere vegetable productions. He also asked if the laws laid down held good to any degree in reference to the downward progress of the tree as well as the upward—to the ramifications of the roots as to those of the branches?

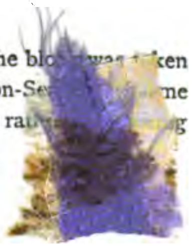
Mr. SAWYER gave instances of the continual variation of the growth of trees.

Mr. LOMAX replied to Mr. Haselwood that he looked upon the forces which he had mentioned in his paper as forces of vitality, which had to give way to the ordinary mechanical laws, and that he had not studied the downward progress of the tree.

Mr. C. F. DENNET also took part in the discussion.

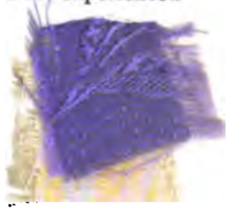
CURIOUS ARCHITECTURAL SPECIMEN.

Mr. T. W. WONFOR, one of the Hon. Secretaries, brought forward a large stone block, which, he pointed out, had on one side ecclesiastical carving common to the thirteenth century, and, on the other, *civil* carving belonging to the seventeenth century. The block was taken from a house of Mr. H. Gorringe, at Kingston-on-Sea, [illegible]me alterations were being made, and, being of a ra[illegible]g character, was forwarded to the Brighton Museum.



IMPOSITION.

Mr. C. F. **Dennet** submitted specimens of imitations of silk, the cheapness of which, had they been silk, attracted his attention. The fabric, however, was almost jute alone, so manufactured as to appear silk to the untutored eye, and to deceive the touch of an experienced person.



FEBRUARY 25TH.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON "THE SCALES OF BUTTERFLIES."

Among insects, scales were not confined to any one group, though they were found on every member of one division, the *Lepidoptera*, the scale-winged, as their name implied, but in connection with microscopical work the scales obtained from certain insects had been, and still were, favourites with microscopists, very deservedly, because, through differences of opinion as to the markings on sundry scales, together with an attempt to resolve those markings, we owed the great improvements made in objectives since the achromatic microscope had been an instrument of research, and not a mere optical toy.

As all knew, certain scales, such as those from the gnat, *Lepisma, Podura*, or *Lepidocyrtus*, and three or four butterflies, viz., a blue and a white of English origin, and a couple of gorgeously coloured foreigners, had been employed, along with sundry siliceous valves of plants named diatoms, as *test* objects, and our objectives had been considered up to or below the mark accordingly as they were able or not to resolve certain figured markings, seen by objectives of particular aperture and magnifying power. Again, to enable these objectives or others of different aperture and power to resolve the same or other markings, various adjuncts to the microscope had been devised, such as condensers, prisms, &c. And though many, alas! too many, microscopists in this country had spent nearly all their time in trying to see exactly the same things that other men had, or said that they had, seen, yet within the last few years a very considerable addition had been made to our knowledge of many physiological facts, as well as the resolution of diatom and scale markings; and though we might not [illegible] all Dr. Royston Piggott's conclusions, yet had he not [illegible] object through his "*rouleaux* of *beads*" and "green [illegible] have gone on plodding in the same steps as those [illegible] cepted one view of an object as a sufficient *test* of the [illegible] ctive.

Whatever view was taken of the markings of scales, there seemed no manner of doubt that the scales of insects were nothing more nor less than modified hairs, of greater or less thickness, more or less flattened or cylindrical, according to circumstances and their position on the body, legs, or wings of the animal on which found. If then we regarded all scales as only modified hairs, and considered that *hairs* were composed of cells, we might see our way out of the difficulties into which the learned amongst microscopists had led us, and we might also understand an *under and upper surface*, two *laminæ*, *striated surfaces*, *ribs*, and sundry other puzzling terms which had come into existence when speaking of scales.

Those who had written or spoken about scales and their markings within the last few years, were Dr. Royston Piggott, and those who inclined to his *beaded* theories on the one hand, among whom must be included Mr Slack, one of the Secretaries of the Royal Microscopical Society, and on the other Colonel Woodward, Dr. Maddox, Dr. Anthony, and Mr. McIntyre. It was with the latter group he felt he must ally himself, because much, if not all, of the so-called structure described by Dr. Piggott he believed was purely optical and not structural.

Primarily, the scales of insects, and specially the *lepidoptera* were more or less flattened hairs of a cylindrical or tube-like shape, inserted by a pedicle, differing in character according to circumstances, into the wing membrane, on both sides of which they were arranged in symmetrical rows, like the tiles on the roof of a house. The majority of those on the wing, or rather the flat part of the wing, were flat, or nearly so ; interspersed among them were others quite hair-like in their character, and in some cases, to be attended to presently, were some which were balloon-like in shape and, he believed, were capable of being inflated like a balloon. He should mention that from six to eight different kinds, or rather shapes, of scales were found on each butterfly or moth, and when it was borne in mind how many thousands of moths and butterflies were known to science, it might be imagined that, though the varieties were not commensurate in number with the varieties of the insects themselves, yet the varieties in shape and markings were very numerous. Anyone devoting a little time and attention to scales would be well rewarded for his pains, and would learn far more by comparison than he could possibly glean by studying one or two special scales.

Among other points he would find that the colour of insects was not always due to what to the eye appeared the colour on the wings ; a striking illustration of this was seen in the case of the common orange tip, the green colour on the back of the wings proved on examination to be produced by an intermingling of black and yellow scales. Some certainly owed their colour to pigments, but in a great many it was due to the incidence of light, for if, while under examination under the microscope, the stage were rotated, as great a change would be seen in colour as with some objects under polarised light. Seen as transparent objects, brown seemed the prevailing hue.

Again, if scales were taken from living insects or from those recently killed, and gently squeezed by pressure on a thin covering glass, greenish oily particles would be seen to ooze from the pedicle, leading to the idea that in the living insect there was something like the circulation of a fluid from the wing membrane. It was certain they would not require any fluid to repair waste or to accelerate growth, because they were of full size the instant the insect escaped from the chrysalis. There was no growth proper in the scales, any more than in the wings. The instant the moth or butterfly emerged from the pupa case, it came forth full-grown, the membranes expanded laterally and longitudinally, and by so doing the scales of the full size and *in situ* were simply drawn wider and farther apart, but of growth there was none. This could be seen by cutting open the pupa case just before the emergence, or taking the wing of a recently emerged insect. This must be done at once, because in some cases, within ten minutes of the emerging the wings were of full size. There was, therefore, no replenishing of waste nor reparation of parts in the scales of lepidoptera, as in the hairs of the mammalia.

Nor could we trace in all scales the cuticular layer, cortical substance, and medullary substance of such hairs ; we seemed to obtain a cortical substance, with or without a cuticular layer, and sundry rib-like strengtheners, which had given rise to the diversity of opinion as regarded structural markings. There was another curious fact sometimes noticed—viz., that there appeared to be a power on the part of the insect to raise the rows of the scales as well as to inflate some scales. He had often found the scales on the wing of a butterfly caught and killed in flight, not lying flat to the wing membrane, but raised on it at a more or less acute angle, as though in flight the insect possessed the power of raising the rows of scales. This might, if we imagined the power of inflation of the scales as well, give greater buoyancy to a butterfly or moth in flight. He had every reason to believe this to be true of some scales ; if so, it would give to the wing membrane with its nervures a power not accorded to it in Manuals on Entomology.

It was now twelve years ago he started one afternoon with a medical friend to look for a certain fern, said to grow about twelve miles from Brighton. They got out of a train at the Hassock's Gate Station, and diverged a little from their course to see whether *Neottia Spiralis* (autumn lady's tresses), the orchis which Darwin watched the bees fertilizing, by carrying the pollen masses from one flower to another, was in flower. While searching for this plant, some blue butterflies got up. His friend and he managed to catch several. This fact was strongly impressed on his mind, because, after walking nearly a mile, they retraced their steps to search for a stethoscope, which, in the eagerness of the chase, had dropped from his friend's hat when catching a "blue."

On the way they both talked over the question of why they had not been able to find "battledore" scales on blue butterflies. Was it they were only on one kind, for though they had both searched for them on the part described in the Micrographic Dictionary, p. 564, under *Polyommatus*, they had neither been able to find them. The words there run, " The scales upon the under surface of the wings of

P. argiolus and *P. argus* have been proposed as test objects. They are of two kinds—one resembling in structure the ordinary scales of insects, the other of a battledore form."

What his friend did with his blues he did not know, he (Mr. W) carefully removed the scales from the under surface of one of the blues and found not a single battledore. Having placed a wing upperside downwards on a glass slide to enable him to search over the wing, he found, after a futile and long continued search, that a considerable number of scales detached from the upper surface of the wing were upon the glass slide; focussing down to these he found battledores in plenty, but not exactly like those figured in the book. He then realised this fact, that battledores were to be found on the upper surface of the wings of *Polyommatus*, or, as it was now called, *Lycæna alexis*, differing in form from those figured as obtained from *L. argiolus*. This led him to try whether he could find " battledore " scales on other blues than *L. alexis*, the common blue, or *L. argiolus*, the azure blue, for to those unacquainted with such differences among " blues " he should mention we had, in England, nine different species of " blues," such as the Common, Azure, Clifden, Mazarine, Chalk-hill, Silver-studded, " large " and " little " blue, and rare " long tailed " blue.

Through the kindness of an entomological friend he secured examples of nearly all, and, strangely enough, found battledore scales on the upper surface of both wings in some cases, and not in others. It turned out that the insects on which he had been unable to find battledores were *females*, while those on which he had found them were *males*. This caused him to make a critical examination of the blue family generally, and he then discovered these two facts—the battledores were found on the upper side of the wings of the males *only*, and in rows beneath the ordinary scales, and at their intervals of overlapping. He should mention that, among the blues, the males only were of a deep blue colour; the females generally were of a brownish hue, with a few blue scales, and this might have led to the assertion that battledore scales were found on the " blues." It was true some females adorned themselves with so great a profusion that they simulated the garb of the males, much in the same way as the erstwhile " weaker sex " among humanity, since the cry of woman's rights had been raised, assumed the get-up and garments of the " lords of creation," but on no female, however highly coloured, had he been able to find " battledores."

Since then, he had had the opportunity of examining many foreign and tropical blues, and in each case, even when the female assimilated closely in colour to the male, only on the male, and invariably on the upper surface and in rows beneath the ordinary scales, had he found battledores. As might be expected, these battledores differed in size and shape—the blade was longer or broader in some than others relatively, the top was more or less rounded or squared, while the length of the handle or pedicle varied in length, so that, when two species of blues resembled each other very closely in their markings, the shape and size of the battledore might be used as a ready means of settling species. There were species among the Lycænidæ in which neither males nor females were "blue" or "bluish" in colour, and, curiously, among these no single example of male with "battledores" had been found. Mr. Watson, who was working on "plumules" at the same time he was carrying out his investigations, had had opportunities of examining some hundreds of species of "blues" and "brown" among the Lycænidæ, and had never met with "battledores" on any but the "blue" proper.

He would turn next to another characteristic scale, the "tasseled," described in the "Micrographic Dictionary" under the head of Pontia, p. 571, thus—"The form and structure of certain scales existing upon the *under* side of the male is curious." Here, too, as he should show, the writer had made a slight mistake, instead of ***under*** they should read ***upper***, for it was there, and there only, they would find scales similar to those figured in the "Micrographic Dictionary." As might be supposed, having got an inkling from the "blues," respecting the situation of "battledores," he was not long before he searched the whites. The first to come under examination were the "large" and "small" cabbage white ***Pontia***, or rather now ***Pieris brassicæ***, and ***P. rapæ***, both of which gave on the upper side the characteristic scales called "tasseled," or, as some preferred, "plumules." These scales differed essentially from the "battledores" in shape, ornamentation, markings, and pedicle; some were long and very slender throughout, and gradually tapering to a point, others seemed cut short, while others comparatively broad at the basal end, suddenly narrowed and terminated either as though cut short or fined off to a slender point; all, whatever were their comparative breadth and length had a cup-like or ball-and-socket termination to the pedicle. At the apex of each scale was a tasseled fringe of great beauty, from which circumstance they had been called "tasseled" scales. All our English whites, together with the orange-tip, possessed these peculiar scales, and if the great family of Pieridæ, which included a vast number of continental and tropical forms, were examined, they would find the males invariably possessed a tasseled scale, either of the form of our English whites and orange-tip, or a modification of these, both as regards the terminal fringe and the pedicle. He had had opportunities of examining a good many, but Mr. Watson had enumerated upwards of 200 English and foreign Pieridæ examined by him, on which, in every case, the males, and the males alone, possessed the characteristic scale.

As might be supposed, there were great diversities of size and form, and which, from what had been said respecting the English Pieridæ, might doubtless be very useful in determining species. One curious confirmation of the value of these characteristic scales Mr. Watson drew his attention to in 1868, viz., that two hitherto-believed different species of *Pieris* turned out to be the male and female of the same, the one having, and the other being without, the characteristic scales. They were arranged in rows behind the other scales, as in the "blues," but many being long and hair-like, they appeared only as hairs *in situ.*

The next English family to be noticed was that named *Hipparchia:* the common meadow brown *H. Janira* had a scale brush-like, tapering like the large white, but differing from it in the markings in the ribbon-like portion, as well as having a pedicle similar to that possessed by the "blues." Investigating this family, he found the same story told throughout—a distinctive scale, ribbon-like, and tasseled on every male of the family, but never a scale of such a character on the females.

In each of the families described there was generally a difference of wing-markings between the males and females; occasionally they resembled each other, and some few insects had been found with the wings on one side with the male markings, and on the other side with the female markings. It would be very curious to find out if, with this assumption of marking, they also on the male marked wings had this undoubted sex distinction.

There was only one other family of English butterflies possessing, as far as he had been able to make out, a characteristic scale, and that was the *Argynnidæ* or Fritillaries, or, at least, those among them the underside of whose wings was marked by metallic spots. The male scales were of a very decided character, differing essentially from those of the *Pieridæ*, on the one hand, and from the *Hipparchiæ*, which they somewhat resembled, on the other. Some were of a very long, narrow, and ribbon-like form, with the tassel at the apex, while others were shorter and broader. Some, too, like the *Hipparchiæ*, were nearly opaque, except at the apex, while others had the ribbon-like portion opaque for one-half its length. The position of these scales on the wing differed from that of any others described, for, instead of being placed in rows beneath the ordinary scales, they were situated on the nervures or black veins of the upper surface, and had mingled with them in some species very peculiar Indian club-shaped scales or hairs. Mr. Watson, whose opportunities of examination had been far greater and more extensive than his own, had found "plumules," as he calls them, on thirty genera of butterflies, or nearly 600 species. In every case they were found on the male insects alone.

He consequently drew the inference, a very reasonable one, that battledores, tasseled scales, or plumules, wherever found, were characteristic of sex, and that of the male sex. What purpose they served in the insect economy was not yet clear. Their paucity or abundance on individuals could not be, as some had suggested, marks of greater or less virility, because, as had been seen, scales did not grow with the age of the individual, nor did they find more scales on one freshly-emerged butterfly than another of the same species. They might render the males more buoyant on the wing ; but here they were met by this difficulty, well-known to field entomologists, the females were more rapid in their movements, in most cases, than the males.

They seemed rather to be the analogues of the beard in man, the mane in the lion, the comb in the cock, or the more brilliant plumage of some birds, and, possibly, to insect eyes rendered their possessors more attractive than the duller-coloured and non-plumuled sisters of their species.

There were many debated points of structure he scarcely felt justified in touching on, because he had rather dealt with the scales as a means of differentialising species or determining sex, and not as tests for objectives.

In obtaining the scales for examination, he had found the best way to examine a wing was to lay it on a clean slide, then place another clean slide or covering glass upon it and gently press. Upon removing the upper slide or covering glass, plenty of scales would be obtained in their relative positions. The covering glass could be mounted, or if a ring of cement was run round the slide, a cover added, and, when dry, a finishing coat were put on, the slide was ready for the cabinet. He feared he had been too prolix in his remarks, and not added any new fact to the store of the members of the Society; but if he were able to enlist one to pursue the study of scales of insects, he should have done his quota towards the use of the microscope as a means of research, for there were many paths open, besides the beaten tracks, by which not only, if that was needed as a spur, fame might be won by the discovery of new facts in physiology, but much pleasure and interest might be derived by prying into the secrets of Nature hidden from the unaided eye.

The paper was illustrated by chalk drawings on a blackboard.

A discussion followed, in which Mr. HASELWOOD, Alderman COX, Mr. DENNET, and others took part.

The meeting then resolved itself into a conversazione; when a number of slides, showing the different scales and the wings of butterflies and moths, were examined under the microscope.

FEBRUARY 29TH.

ANNUAL SOIREE.

The Fifth Annual Soirée was held at the Royal Pavilion with great success, some six hundred members and friends being present.

Flowers and plants were judiciously arranged about the rooms, and in the Corridor the staircases at each end were banked with evergreens, whilst the fire-places were filled in and the mantel-pieces decked with floral adornments, Messrs. Balchin and Nell carrying out this portion of the arrangements.

In the North and South Drawing Rooms, the Saloon, and Banqueting Room (where also light refreshments were supplied by Mr. Booth), various objects of interest were set out for inspection, the numerous microscopes, and other scientific instruments belonging to the members of the Society, very appropriately engaging the chief share of attention. Amongst those exhibiting microscopes were Mr. S. Aylen, Mr. W. Ardley, Mr. J. Capon, Mr. T. Cooper, Mr. J. Dennant, Mr. J. Gwatkin, Mr. R. Glaisyer, Mr. E. Glaisyer, Mr. J. E. Haselwood, Mr. B. Lomax, Mr. Mills, Mr. Moore, Mr. W. Mitchell, Mr. Moginie (Quekett Club), Mr. G. Nash, Mr. Pankhurst, Mr. W. Puttick, Mr. H. Saunders, Mr. G. D. Sawyer, Mr. Welch, Mr. T. W. Wonfor, Mr. T. W. C. Wonfor, Dr. Hallifax, and Dr. Tuthill Massy. A very conspicuous centre of attraction was a huge case, three yards long by two yards high, containing a pair of splendid mute swans, with cygnets, which occupied one side of the Saloon. These noble birds, which came from the Norfolk Broads, were lent by Mr. E. T. Booth, the owner of the Dyke-road Museum, and excited much admiration. They were mounted and stuffed by Mr. Savile, in the short space of one week. The artificial foliage was remarkably natural, and here and there a close observer could discern snails, caterpillars, &c., modelled to the life. Arctic birds were exhibited by Mr. Pratt; Miss Glaisyer contributing others, and the same lady had a very fine case of shells on view, some of them being exquisitely beautiful. A number of " Eskimo" articles, from Disco Island, where the Arctic Expedition touched, were shown by Mr. H. Willett, as well as a number of photographs relative to the search for the North-West Passage, by Alderman Cox. A curious Indian bow for slinging stones, an assortment of woods used in manufacture, and a strange weapon, of ibex horn, from Somali, were shown by Mr. W. Saunders. Considerable interest was also manifested in a series of illustrations by Dr. Corfe, of the hands and feet in animal life, whilst those fond of geology found scope for investigation in the drawings of, and cores from, the Sub-Wealden borings (which had just been completed for the Scientific Exhibition at South Kensington), lent by Mr. H. Willett.

Mr. E. MOORE, Corporation Analyst, had a very interesting assortment of various descriptions of butter and cheese from all parts of the world; his table being much admired for the very tasteful manner in which the wares were set forth. Ivy, trailing leaves, moss, butterflies, and other insects, were skilfully used to adorn the palatable-looking ornamental pats of butter, and doubtless in this regard many ladies got a hint which will not be thrown away. One of the specimens deserved special mention,—that sent by Miss Hadlow, of Uckfield. The young lady milked the cow, made the butter, and manufactured the very pretty basket in which it appeared at the Soirée; and, what with tasteful adjuncts in the way of flowers and ferns, she carried off the first prize in the minds of the numerous critical inspectors. Mr. H. Bull, of Hurst, also sent a miniature hamper of butter, which looked all that could be desired.

Superb collections of English and Foreign beetles, were contributed by Mr. Dowsett; butterflies by Mr. Colling; and Indian butterflies and moths by Mr. Wills, occupied other tables, whilst no one could fail to appreciate the beautiful skeleton leaves prepared by Miss Gwatkin, and in the arrangement of which the greatest taste and skill were manifest. Mr. C. Bellingham's fine assortment of casts of medals and cameos attracted considerable attention; and another great object of interest was a beautiful shell basket shown by Mr. Cox, that gentleman also exhibiting some splendid specimens of the lyre bird.

Electrical instruments of the most approved character were lent by Mr. Whiting, of the Post office, and many of the company amused themselves by forwarding messages to each other; whilst electricity under another aspect was seen in its application to vacuum tubes, producing some beautifully tinted fireworks; Mr. J. Capon being the demonstrator. Mr. C. J. Rowsell had his combination graphoscope and other fine instruments on view, and various other apparatus and objects of interest, including some excellent photographs shown by Mr. D. B. Friend, were placed here and there about the various rooms.

During the evening, the following addresses were delivered in the Music Room. The first was by the President.

Mr. J. **DENNANT** said it is usual on these occasions for the President to offer a few informal observations preparatory to the work of the evening. These, I think, are fitting occasions when we may fairly bring before your notice the work of our Society. I may say, to commence, that we are in a most flourishing condition. Financially, we are extremely healthy, and the number of our Members is something over 200. We have an excellent and valuable library of over 900 volumes of standard scientific works, and I am glad to say that the library is now used by our townspeople without let or hindrance.

During the last year we have had a series of papers of a very valuable character read before the Society. I propose to mention them, that you may see the class of subjects which come under our attention. The first to which I will allude is one delivered last year by our very eminent townsman, Mr. Davidson, F.R.S. He was generous enough to make known, through our Society, his original researches in geology, and he gave us the gist of his observations on brachiopods, in a paper entitled "What is a Brachiopod?" Mr. Dennet followed with a paper on "Vegetable Fibres," and Mr. F. E. Sawyer read another on "The Birds and Mammals of Sussex." Our good and untiring friend Mr. Wonfor discoursed "On the Brighton Aquarium, and what it has done for Science." Then came Mr. B. Lomax with a paper on "The Minor Diseases of Plants," and Mr. Pankhurst with one on "The Ores of Iron." Next we had a paper from Mr. Potter "On the so-called Forest Beds." Mr. Wonfor, who always comes in when any of our friends fail us, gave a second paper on "Manna;" and we had a valuable paper read by Dr. Hallifax on "The Nervous System and its functions." This was followed by Mr. C. P. Smith's paper "On Bees," which proved very interesting, and still another from Mr. B. Lomax on "The Branching of Trees."

These papers have been so amply reported, that it would be unnecessary and unwise to detain you further with them, except to remark that the majority of these papers were considerably in advance of ordinary merit, and, indeed, would have done credit to any of the learned Societies of this country. Most of them evinced no inconsiderable amount of original research. I think that man has missed a very important element of happiness in common every day life who has not cultivated his mind and provided for himself an intelligent and rational pursuit, such as the study of literature, science, or art. You who are working hard in your profession or business, pause before you allow your life to slip away without the study of some subject which will elevate the taste and lead you out of yourself for the time being, and provide you with a mental tonic which will brace your mind with fresh energies for your ordinary pursuits (hear, hear). It is a matter of great importance that young people should have a knowledge of natural history or natural science generally. It is a matter for congratulation that those estimable persons who have undertaken the charge of educating the young are awaking to a knowledge of this fact. Messrs. Macmillan have, I notice, recently issued an admirable series of science schoolbooks and science primers, so that really a child of ten or twelve, and of ordinary intelligence, may become acquainted in the most interesting manner with the elements of science in its various branches.

I venture to express the hope that the occasion of this meeting will be made of great use for the good of our Society. Although we have a large number of members, we are anxious to increase them. We are always happy and willing to receive young men—students who are just beginning to interest themselves in science. We should also be glad of a few more men of advanced and cultivated mind, and there ought to be many of these in such a town as Brighton. Men who have devoted time and attention to science, and who, having come to settle here, ought as far as possible to identify themselves with the town through our Society. In these days of shifting opinions and progressive intellectual development, it is of the highest importance that our young men should have their minds trained to exact habits of thought. I think the study of one or more branches of natural history one of the best means of cultivating a careful and correct judgment. It is, perhaps, impossible to give oneself to the study of scientific facts without unconsciously acquiring a love of impartiality and truth. Science is advancing with such strides that it is difficult to keep pace with the discoveries made from time to time. I would allude in particular to Mr. Crook's experiments on the dynamic force of light. He allows the light to penetrate through a glass vessel under which, *in vacuo*, is suspended a spiral thread of glass, with a small steel weight attached, and the twisting and untwisting of this spiral thread, as registered upon the vessel, gives him the measure of the twisting power exerted. Mr. Crook calculates the power exerted by the sun's light is equal to 32 grains in the square foot, 57 tons on the square mile, or three thousand million tons on the whole earth's surface. This enormous repellent force, but for the far more powerful attractive force of gravitation, would drive the earth off into space. This tremendous statement must, however, be accepted with reserve, for it is doubtful whether heat as well as light is not a factor in the experiment.

I should like also to allude to Mr. Proctor's latest book on "Our Place in the Infinities." After working on the subject for a long time, he has come to the conclusion that Sirius, or the dog-star, is a giant sun, with five attendant satellites. He says the latest appearance of Sirius appears to suggest that in connection with this giant sun, as he terms it—a sun more than a million times as distant from us, 4,000 times as big as our own sun, and with a disc 300 times as large as ours—there appear to be certain fixed planets, or, rather, to speak popularly, non-luminous, already cooled-down suns, on which it is quite within the possibilities of things that life like that of our tiny planet, though on an infinitely vaster scale, might exist. These are calculations to make us ponder and reflect, but being based on mathematical principles, they are probably calculations which may be accepted. Ladies and gentlemen, it gives us great pleasure to see you at our Soirée; but you will understand things of this kind are not got up without trouble and expense. Fortunately, we have two matchless Secretaries in Mr. Wonfor and Mr. J. C. Onions, and the successful result is mainly due to their labours, though they have been ably assisted by our good friend and librarian Mr. R. Glaisyer, and Mr. Saunders. I may say our Society is in affiliation with those of Lewes, Eastbourne, Chichester, Croydon, Belfast, Glasgow, and West Kent, with the Geological Association, and with the Quekett Microscopical Club. We exchange transactions, and our officers for the time being are *ex-officio* members of each of these kindred Societies. This will show that we are doing our work, and making our way in the interests of science in this town. But I am travelling beyond my original intention. I am to be succeeded by Mr. Merrifield, who will discourse to us "On 1900." Many have asked me what that may mean. If we ask 1,900 times, echo will answer, "What?" Perhaps he has made a great anthropological discovery of 1,900 ancient Britons, whose achievements he is to celebrate, as Tennyson celebrated those of the gallant 600. I should not be much astonished to find he wants £1,900 for the new Science and Art School; if he did, you would be sure to respond; you could not do better for your own honour or the good of the town. Mr. Haselwood will read a paper on "Evolution." The word need not frighten you, for Mr. Haselwood has read and thought a great deal about the subject, and has all the ability to talk about it in an interesting manner. Mr. Mayall promises a lecture on ancient and modern astronomy contrasted. He has studied the subject for many years, and may speak with authority upon it. Mr. Moore will lecture on butter. I am afraid it will prove a painful and disagreeable subject. Really we do not know what we eat, and I fear he will make you uncomfortable on the subject of adulteration of butter. I have been forcibly reminded this evening of the line of Watts, "How doth the little busy bee improve each shining hour." The hour is not shining, but the bee is busy swarming in an adjacent hive. I am glad to find it has not affected in any way our gathering this evening. If I have spoken to you in an informal way, it is because I felt that with the important lectures before us this evening a more elaborate address would be beside my duty.

MR. F. MERRIFIELD ON "NINETEEN HUNDRED."

It is sometimes good to look backwards. I believe it is often better to look forward. Each of these views indeed—the retrospective and the prospective—equally gives rise to a diversity of feelings. In some persons, the retrospect only calls forth a lament over the good old times departed, in others it evokes a feeling of contentment with the advances made; in like manner, the anticipation, while in some it awakes alarming apprehensions as to the fate of all those institutions that are most valued, in others it arouses the glowing aspirations that spring from a contrast between the present and, if I may use an expression that seems like the name of a tense not known to grammarians, "the perfect future." You know that there have been several histories of Brighton, the last of them by that wittiest member of the Aldermanic body, if the rest will pardon my calling him so, Mr. Alderman Martin. I propose to give you a few features of the history of the same place, and to do so, without in any way trespassing on the ground occupied by the worthy Alderman, or the historians who have preceded him. I am going to ask you to pass with me at a bound from 1876 to 1900, and to look at Brighton as it will present itself. This is really history, only seen from the other end; and it has this advantage over the usual, but inaccurate, form of history, that I shall be able to defy all the world to disprove a single word of what I shall advance. Any of my hearers may, indeed, disbelieve me, but in so doing what will he do but earn for himself that most opprobrious of names, a sceptic? Imagine me, then, as venerable in appearance as I may hope to be in 1900, while I give you this sketch of the town as it may appear in that Year of Grace.

The population, according to the last quinquennial census, was 157,053. Regency-square is about the centre of the town: it has a very old fashioned look, and one can plainly see that the pier—built about 40 years since -was no spontaneous growth of that sleepy looking square; sleepy and bald, for it still displays a bare expanse of grass, visited by no one but the gardener who has to mow it, its monotony unrelieved by a single flower or shrub. It seems there is one inhabitant who stands out against reform—an old lady, born at a period when it was thought no part of a parent's duty to train the intelligence; and, therefore, like many "old girls of the period," quite inaccessible to reason. The streets of the older part of the town are mostly too narrow for trees; but, wherever they are not so, the Municipality has planted them; and, as a consequence, lines and clumps of verdure relieve even the most desolate-looking parts of the town. Where trees would intercept the sea view, lower objects have been well planted, and are carefully tended; so that the shrubs, while not trimmed into unnatural shapes, but breaking into all the variety of outline that belongs to them by nature, are clothed with foliage from the very ground; and the flower beds, though the "raised pie and jam tart" patterns have been abandoned, show no unsightly patches of bare earth. The efforts of the municipal authorities have been fully seconded by the householders. The architect has come to own that, however beautiful may be his own creations, these of his brother professional men are for the most part very ugly, the difficulties inherent to great expanses of brick and Portland cement being recognised as so great that, unless considerable expense in ornament can be afforded, it is nothing but a mistake to make them such striking objects as to invite attention, and that the best plan is to call in the nurseryman's aid to drape them with creeping plants. The consequence is, that in winter the houses appear to nestle in ivy and euonymus, glowing here and there with flame-coloured bands of pyracanthus,—such as even, 30 years ago, might have been seen, as one passed by the Railway, on Mr. Gorringe's house, at Southwick,—or with the brilliant scarlet of the cotomaster, or the large golden fruit of the passion flower; while all through the summer and autumn months they are festooned with Virginia creeper, passion flower, and honeysuckle, and with clematis of every sort, from the one that climbs to the top of lofty buildings and covers them in May with white star-like flowers as freely as it does the deodars on the slopes of its native mountains, to those more late-flowering kinds which, throughout the following months, display in succession their sheets of violet and lilac bloom.

The newer and western part of the town, where the streets were originally laid out for the planting of trees, is, of course, much the most beautiful, and architects have discovered that even rather bald masses of brick and Portland cement may be made agreeable to the eye when shut off by the shade and greenery of trees and shrubs. As used to be predicted by the Officer of Health, Dr. Taaffe, who still survives in a green old age, this abundance of verdure has purified the air and improved the health of the population, as well as their dispositions. I remember in my younger days that there was a notion that trees would not grow in Brighton ; of course, all that was necessary was to prepare the soil and make a good selection of kinds. I have heard, too, that thirty years ago, or even less, the local authorities treated the foot pavements as the concern, not of the people who walked on them, but of those who lived in the houses opposite, so that it was no uncommon thing to find a street admirably paved except in a single spot a few yards long where it had two or three inches of soft mud. This is very much as if a railway were to be considered the affair of the landowners through whose estates it passed, and any of them was at liberty to leave an arch of a viaduct unfinished as long as he pleased. Perhaps you will hardly believe this, but I can assure you not only was the fact so, but, at the time when the practice prevailed, there were plenty of people to justify it and to declare it was the only reasonable one.

One of the causes of all the improvements we witness, no doubt, was the change that has taken place in the condition of the people. Thirty years ago one in eighteen of the population of Brighton were paupers. It has now long been recognised that a country may have just as much pauperism and crime as it desires. Perhaps you will scarcely credit me when I tell you that when I was approaching middle age the State had scarcely taken any step towards the prevention of these great evils. Parents were at liberty to allow their children to run wild in the streets, growing up in ignorance even of reading, writing, and arithmetic ; they might even encourage them to beg and train them as thieves, and no questions were asked ; and, with the notorious fact that troops of children were allowed to grow up in this way and would almost necessarily become vagabonds and criminals, no effort was made by the constituted authorities to reclaim them. If, indeed, a crime was committed, or even if those wretched outcasts made themselves a nuisance to respectable persons by begging for food, then society came down on them with a heavy hand; the only notice taken by the State of those who were neglected by their natural guardians being to punish them when they did that which was the necessary consequence of the conditions under which they were permitted to live. It was not till 1870 that the principle was recognised that parents were bound to give their children elementary education, and that when they were too poor to do so a child's future was not to be sacrificed to the desire of its parents for the services of the child in attending on them, or even on their babies; and when the obligation was made a legal one, every sort of obstacle was thrown in the way of those who had to enforce it. It was not until five years later that an Industrial School was established in Sussex, to which children neglected by their parents, but unconvicted of crime, could be sent. Can it be wondered at that, in such a state of society, the classes that held a position affording them comfort and refinement, lived in a state of chronic apprehension of those below them in the social scale, and—more especially in some foreign countries, where the circle of enlightenment was a smaller one than in this country, looked on them with a shuddering alarm such as that with which the luxurious inhabitants of the Roman Empire regarded the barbarians whom they knew only as savages and enemies?

I can remember, and not so long ago, when there were certain districts in all our large towns which seemed abandoned to vice, and which no decent man or woman would traverse without necessity, and when you could not pass an assemblage of young fellows belonging to the class of ordinary labourers without the chance of having your ears assailed by some of the worse words known to our language, used without reference to the subject matter, and as if it was a positive pleasure to say what was coarse and ribald. It is scarcely to be wondered at that the great aim of persons belonging to the classes so unfortunately situated was to get out of them. This was even thought a very meritorious object of ambition, and it was no uncommon thing to hear those who were seeking to make themselves agreeable to an audience of working men point to a shop counter in the first generation, a seat in Parliament in the second, and a peerage in the third, as successive stages in the upward path of virtue. We do not discourage such efforts to rise in the present day, but certainly reserve our highest admiration for those who, instead of seeking to escape from evil, pursue and destroy it.

As a consequence of this change in public sentiment, we find there is no class now that is left abandoned to vagabondage or vice. Drunkenness, as an openly practised vice, is now rare, and if a person is found committing it two or three times, he is very properly put under lengthened restraint. Twenty-five years ago there was no such provision. The same person might be convicted more than twenty times of drunkenness, and all that the law allowed was to fine the offender, or send him to prison again for a short term. You will not be surprised to hear that very often half-a-dozen men and women appeared in the dock morning after morning on the charge of being drunk and disorderly. Most of what are now our Industrial Schools were then prisons, in which hardened offenders were employed for hours every day, in turning a crank which ground nothing, being all the time maintained at vast expense to the public, who were crushed with rates and taxes. Our army was then an institution in which the standard of conduct was popularly considered much lower than that of ordinary civil occupations; now, as you know, it is as moral and well-conducted a body of men as any in England. The theatres were then very different from what they are now. I can remember when many clergymen thought it sinful to go to them; and there is no doubt that, although they invited the presence of the higher classes, and were considerably patronised by persons of enlightenment and culture, you would often hear and see things that would have been simply intolerable in society. This was supposed to be done to please the gallery. Now that the spirits of brutality and coarseness are exorcised from all ranks of society, there is no excuse for such things, and they have consequently disappeared, and, as you know by your own daily experience, the stage may be as pure as the drawing-room, or, perhaps, the pulpit, and I dare say many of you think, much more amusing.

With the general spread of refinement downwards, or rather anticipating and in great degree causing it, has come a general shortening of the hours of labour—of course, as workmen have become more efficient and reliable, the amount of labour necessary to maintain the population has been much reduced. The navvy and the agricultural labourer, who generally spent ten or twelve hours a day in exhausting labour, and too often had no pleasure to look forward to but a bout of intoxication at the end of the week, now finishes at so early an hour that his evening can be devoted to recreation, or, if he prefer it, to study; and that he does this to a great extent, you know by the returns of the large number of books circulated from the Public Library among these classes. The mention of the library reminds me of a meeting I attended about 40 years ago to adopt the Public Libraries Act. It soon appeared that the promoters were in a small minority; they were hissed and hooted. At length, a spokesman of the majority appeared who looked the embodiment of his principles; he uttered a few strong sentences decidedly in accord with his appearance, and I shall never forget his peroration, which he concluded amid the rapturous applause of the meeting with the phrase "Eddication is a cuss."

One of the greatest improvements has been in the processes of voting and elections so frequent in all highly civilized communities. Formerly the system was so rude that it afforded no security, either for representation in proportion to the prevalence of opinion, or against the return of a candidate whose sentiments were opposed to those of the great majority of the electors—this latter result often happened when the majority could not at first agree on one candidate out of two or three offering themselves. My younger hearers have no conception of the passion imported some years since into political and religious discussions. Even in politics a large number of persons would habitually get so excited when they discussed them that they could not reason at all about them, but only harangued, and assailed with vituperation, those who did not agree with them. Now, as you know, people can reason about them as calmly as they do about history or political economy. The more moderate spirit with which religious controversies are conducted is probably owing to the discovery made in recent times, that what thoughtful and excellent people who have studied the subject agree in is more likely to be true, and, probably, at this late stage of mankind's existence, more important than what they differ about. You know how large and influential is now the body of those who hold to this principle, and who, so far as they have a distinctive name at all, call themselves "true Catholics."

A truth which was not much recognised until recently is that no man can personally enjoy property after he is dead. As a consequence persons show a much greater disposition than formerly to make good use of it while they are living. We do not now call a person charitable who only leaves his property by will to charitable objects, because what he thus gives to them he takes, not from himself, but from others. The habit of accumulation was so strong that if a millionaire presented a park or a costly public building to a populous town, even when by so doing he did not deprive either himself, or any of his children, of a single comfort or enjoyment, he was thought to do an extraordinarily liberal thing. One of the greatest developments of education during the last quarter of a century has been in the direction of the cultivation of material and physical sciences. You will, perhaps, hardly believe that, until long after the middle of the 19th century, scarcely any subjects were studied at the Universities and Public Schools but the classics, as they were called, *i.e.*, the language and literature of ancient Greece and Rome, and mathematics, and nearly all the other schools,—even those, the pupils in which were intended mostly to be tradesmen or clerks,—followed suit. Now, as you are well aware, science is considered at least equal in importance to the older subjects of study, and every provincial town has its school of science.

I remember the struggle we had to establish ours at Brighton. I recollect Sir John Mayall—he had not been knighted then—was one of its most active promoters. It was out of pure liberality that he made what was then thought (and was so at the time) the handsome gift towards a public object of £100; but he had his reward. He told me as long ago as the year 1890 that it was while visiting the students at work in the laboratory of the Science School on the Grand-parade that the process occurred to him by which aluminium could be inexpensively extracted from the mud of Shoreham Harbour and converted into teaspoons and other articles of plate. This discovery was the germ of that great Metallic Plate and Furniture Factory which he has established at Lancing, an industry that has revolutionised the furniture trade, and has had so large a share in the development of the "Liverpool of the South."

You were kind enough to take with me the leap to A.D. 1900. Will you accompany me as I go back at a bound to 1876—you will find yourself nearly a quarter of a century the younger for it,—and if some of the comments I have penned as seeming appropriate to the future I have conjured up may seem to reflect too severely on the present age, and you are disposed to ask by what right I make these strictures, let me make answer that I claim none, and that I shall be the last to deny the impeachment if I am accused of being one who whilst he—

> Shows you the steep and thorny way to heaven,
> Himself the primrose path of dalliance treads,
> And recks not his own rede.

MR. ALD. MAYALL, M.R.I., F.C.S., ON "ASTRONOMY, ANCIENT AND MODERN, CONTRASTED."

Man is more content with no intellectual light, than with a little, and whenever he has been taught to acquire some knowledge to please others, he generally plods onwards to acquire more to please himself. "So far shalt thou go and no farther" is as inapplicable to wisdom as to the wave. The fruit of the tree of knowledge may stand in the garden, undesired; only, so long as it is untouched,—but the moment it is tasted prohibition is in vain. This has been truthfully designated "the age of enquiry;" everything is, or is not. There can, logically speaking, be no middle path, so far as the things themselves are concerned; but only so far as our limited powers of investigation permit. About the things we know, there can be no doubt; and at the point where this latter operation begins, our knowledge ends. Truth is the real object of some, the avowed object of all; but truth can neither be divided against herself, nor rendered destructive of herself. As she courts investigation and solicits enquiry, it follows that her votaries grow with her growth, strengthen with her strength. What a pity she is little subservient to the interests of party! Oh! how I should love her if she would stick to my church, and believe as I do! but, in her pure, unadulterated state, she is as unfit for currency as pure gold for circulation. Sir Walter Raleigh has observed that he who follows truth too closely must take care that she does not knock out his teeth. But the votaries of truth have little to fear from herself, though much from her pretended friends. Sir John Herschel, speaking of mental purity, observes, "It is the 'euphrasy and rue' with which we must 'purge our sight' before we can receive and contemplate, as they are the lineaments of truth and nature." In the spirit of meekness, and imbued with these principles, do I submit the present enquiry.

On all things created there remains the half-effaced image of Deity—infinite in grand outline, infinite in minute perfection. Nature is the chart of God, mapping out His attributes. Art is the shadow of His wisdom; His own right hand holdeth the first of the golden links in the chain of causation. That He is in all things is an axiom; or else, why this subtle frame-work of thought? this power to penetrate the illimitable past? this thirsting after the boundless future? His law directeth the path of the comet or the particle of dust. His omniscience is as creative in the grain of mustard-seed as in that of a world. The embarrassment and perplexity I now feel ought to serve as a hint to authors to know what to do next. Now, most people have no next. It would have been a consolation if Herschel had not penetrated so deeply into the philosophy of nebulous matter. With him, I assert, that the nebula in the sword of Orion is but the nucleus of a solar system, the crude gatherings of etherial substance; but, in a moment, Lord Ross smashes me to atoms; he tells me they are clusters of stars of spheroidal form, at such immeasurable distances, that their light would have to travel for countless ages to reach this earth. We are told that solitude made a Cincinnatus, that the wise and the learned brood over chaos, where thought and emotion first have birth, that in seclusion's vale are brought forth the most precious fruits.

I withdraw myself from the busy hum of man. I cannot add that I will not borrow—the command has been so often broken by my predecessors; conscience becomes auricular, and whilst pomposity and dulness may stammer out a speech that sendeth the wise to sleep, surely I may be permitted to penetrate the lore of that far-off country where Herodotus was told that the Choen, or men of learning, informed him that the poles of the earth and the poles of the ecliptic had formerly coincided, the traditions of whose philosophers reckon by ages their respective annals; but, without being tedious, and in order that the twenty minutes may not be too crowded, I will endeavour to condense the crude notions of men, unguided by the light of science. How the universe was first produced has ever been a curious speculation and an object of idle solicitude with mankind.

The following theory was the product of Chi-me-ri, an eastern philosopher, of course. Reasoning from the little experience he had been able to collect, he profoundly asserted that the firmament of heaven was merely a chamber floor, with holes of greater and lesser magnitude perforated in it and a large flaming fire kept up behind, the small holes were bored with a bradawl, the larger ones with a gimlet, and the sun and moon with a faucet-wimble. This theory agitated nations; human lives were sacrificed in its support; hecatombs were offered unto the gods in testimony of its truth. I am unable to say how many generations of men it required to outlive this profound theory, until at last it was hinted that when the tap-hole and bung-hole of a barrel are once inserted they always maintain their relative positions, although it was frequently observed that the same law did not obtain with the tap-hole and bung-hole of the sky, for the moon often changed places with the sun, and would sometimes set up her pale face in the east when her brighter companion had hid his charms in the west. Besides, it was urged that the expense of keeping so many and such vast fires alight, was so great, that men, however, began to doubt; cut from the anchorage of Chi-me-ri their bark was a plaything on the billows of chance, and they began even to blush that an imposture so great should, for so many ages, have held their minds in thrall, and entrapped their curiosity; the temples of Chi-me-ri then began to thin, and votive offerings were made at the shrines of Fan-ti-ci.

He still kept up the idea of a chamber-floor to the sky (and we now know the sun would supply him with *beams*). But even his imagination could not supply the fire. He taught that the stars were brass nails of smaller and larger magnitude, driven into the rafters. The very large ones were drawer knobs, and the sun and moon patent reflectors that would have had the power to throw light even into an election enquiry! Old temples were demolished, new ones erected, in honour of this clockwork of the brain, but the cup of wisdom was drained to its dregs, nations ranged themselves under the banners of Fan-ti-ci. Mystery, the high priest of danger, stultified hope; man sought the light of the glow-worm, but scorned that of the sun and moon. Again, doubt pressed his ugly form to the front, and it was gravely hinted that the labour of keeping so many brass nails clean, merely for mankind to look at, was at least an useless one; and, besides, if the whole of the Bristol-of-Chaldea had been made of one brick, and the skins of every animal that had ever lived had been tanned, they would not have supplied the leather and polish for the purpose. The theory fell to the ground from sheer inutility, and the great soap-bubble was obliged to be blown from another quarter. But, alas! I am compelled to add, the grown-up children of science amuse themselves, even now, with theories quite as irrational. They dive so deep, they descend into darkness, or they soar so high that they give us no light. Their puffed nonsense bids fair to blow unpuffed sense out of the field.

To return.—Mankind, after the explosion of this theory of Fan-ti-ci were unwilling to be led by one teacher; and, for a time, the world rolled on in its course, the stars poured forth their light, sunshine, and showers, alternated with cold and heat, sent forth the wine and oil of content. But, on the principle that it is always better to meet danger than to wait for it, the world was dying of inanition, until Bi-go-tri, a learned philosopher beyond the great wall, gave forth another idea, taught that the stars were globes of fire, suspended in the firmament of heaven by a chain, the larger ones by a long, and the smaller ones by a short chain; and this theory began to be generally adopted, until it was suggested that the earth must also be suspended by a chain; but as none of our circumnavigators ever discovered such a chain, from Dampier to Cook, and I think I might even venture as far as Franklin and Parry, doubt, the devil's vestibule, again suggested, if there had been such a chain it could not possibly answer any good purpose. The *curious* would climb up to heaven for the mere purpose of saying, as travellers now do, "that they have been there." The *frivolous*, because they were not wanted, and the discontented to complain, like martyrs, of neglect; little thinking how small a fraction there is in their stunted souls to love, how much to scorn! so that the chain would be crowded from top to bottom like an onion-rope. Besides some unlucky wight, in an unlucky moment, might take it into his wicked head to cut or file the chain; and let the earth, with all her screaming inhabitants, fall! down! down! down!! Ah! who knows where? So much for the speculations of what are called the mythic ages.

Time does not suffice to trace these curious speculations, as they hardened into more probable modes of thought, through the multiform changes in Egypt, Greece, and Rome. The speculation of Zoroaster were transplanted by Bēlus among the Assyrians, age and country uncertain ; later than these by Berōsus who first taught the Chaldean learning to the Greeks, who in their turn founded the principal theories of the universe that agitated the ancient world. The Pythagoræan theory, 498 B.C., built on the rock of eternal unity, has stood the test of ages. That the sun is the centre of our solar system, and although the Ionic school founded by Thales, 600 B.C., comprises the names of the greatest luminaries of ancient times, the Italic school, founded by Pythagoras, taught those principles that have received the stamp of Copernicus, 1543 A.D., of Kepler, 1625, of Galileo, 1643, and our own immortal Newton, 1727 A.D., the greatest philosopher and most profound astronomer that ever lived. He verified the "Laws of Kepler," and applied his profound analysis of the Principia, to explain the harmony of revolving masses, and the balance of the planetary system on the principles of gravity ; so that astronomy has received the name of the Newtonian system, in honour of his transcendent genius. Dr. Halley, Dr. Bradley (aberration of light), Maskelyne, Sir William Herschel, Brinkley, Pearson, Sir Thomas Brisbane, Sir John Herschel, Sir James South, whose famous instruments, including the transit instrument with which most of the valuable work has been performed in the northern hemisphere, are now at work in my observatory at Lancing. To my late friend Admiral Smyth, the author of the "Cycle of Celestial Objects," he was indebted for some of the valuable methods of observance he established with so much labour. Whilst of living men of our own country, he could not pass over Adams, Airey, Dawes, Hind, Lockyer, and Proctor, each of whom has added something towards perfecting the profoundest science with which the intellect of man can ever hope to grapple, and rendered it so accurate, that now, the smallest deviations in the precession of the equinoxes will but add another link to the chain of causation by which our own solar system is held together as part of the stellar universe.

La Place supposes that, at some very remote period, the solar atmosphere extended beyond the limits of the farthest planet. The sun in its primeval state resembled those nebulæ described by Herschel as composed of a bright nucleus, surrounded by nebulosity, which, as it gradually condensed at the surface of the nucleus, ultimately converted it into a star. Now, supposing such a condensation took place, it would have been very gradual. Dynamical laws show how this condensation would increase the sun's rotation, which again would impart greater centrifugal force to the solar matter of interplanetary space, cooling its outer edges and contracting them. This condensation would separate successive zones of vapour, which, by mutual attractions of their particles, would form concentric circles circulating round the sun. These rings would divide into several masses and would circulate with nearly equal velocity; mechanical considerations show how these masses would assume a spheroidal form, with their rotatory motions in the same direction, viz., from west to east, if one of them were of sufficient bulk to unite by its attraction all the lesser masses of the same zone. It is easy to conceive how the planetary system has come into being, the sun rotating from west to east, the planets and their satellites rotating from west to east, and all nearly in the same plane, the motion of rotation on their respective axes being in the same direction, and nearly in the same planes, of their motion of projection. The human mind grows dizzy with the thought!

The whole solar system, then, with the orbits of the different bodies that compose it, would be circles, whose equators would coincide with the solar equator, and if there had been no disturbing causes, such as temperature, unequal condensation, chemical constituents to produce eccentricity of orbits and the deviation of these orbits from the plane of the equator, there would have been absolute coincidence in them; but this very deviation is the key by which mathematicians have been able to show the probability of such an origin. The earth, then, with its attendant satellite may have been thus projected, thus formed from an incandescent mass; and, as it is one of the smallest satellites of the sun, its size being only 1,140,000 part of that luminary, and the planetary system to which it belongs, although 3,000,000,000 of miles in radius, is only one amongst myriads. It depends on the sun, and, therefore, could not have existed before the sun, much less could it exist before the system to which it belongs. The earth, then, although one of the smallest objects in the universe, serves as an exponent of the laws by which the whole is governed. The rays of light streaming in from remote space declare for unity, and in many cases for identity, of substance.

One law prevades the universe. Solar spots and solar phenomena are now the objects of such intense interest that physicists of every country are enlarging our knowledge of the volcanic action of the sun, of magnetic disturbance, and the spectrum analyis of every eruption. Kirchoff, Huggens, Lockyer, Janson, the late Professor Miller, all confirm, by the most rigid analysis, the identity of certain metals in a state of incandescence in our own sun are equally active in Sirius, Alpha-Lyræ, and the principal stars of the heavens, with some additions in the case of Sirius, which exhibits absorptive lines of metals, of which we have no corresponding substance in our own solar system. Again, we have in our own solar system examples of the cosmical theory, now in various stages of progress. All the superior planets, except Mars, have a number of satellites, and Saturn, in addition, a ring of vapour, whilst the sun is now known to be, in its outer film, a mass of gaseous cosmical vapour, and its deep centre one molten mass of metals, common to the earth itself. The immense magnitude of the sun is such that a cannon ball, flying at the rate of 480 miles per hour would take 76 days 19 hours 40 minutes to fly across the sun's diameter; a railway train, at the rate of 500 miles a day, 1,769 days 22 hours 25 minutes to go over a distance equal to the diameter of the sun. In conclusion, Wolleston affirms that the apparent diameter of the most brilliant star in the heavens, Sirius, is not more than the fifteenth part of a second of an arc, but this leaves a good margin for the real dimensions of the star, since, at the distance of Sirius, such an apparent diameter as this would represent a real diameter of 11,000,000 miles, that is, twelve times the diameter of our sun. The sun's diameter is 884,967 miles; Sirius, 10,619,604 miles. Now, the cubical contents of globular bodies are found by cubing the diameter and multiplying by 5,236. The masses of globular bodies are to each other as the cubes of their diameters, this found, divide the greater by the less, and Sirius will be found to contain a mass of 53,977 times that of the sun. Similarly, Vega in Lyra would make 75,532 million earths. The imagination is appalled with such magnitudes, and sinks helpless into the arms of design.

MR. J. E. HASELWOOD ON "EVOLUTION."

Anatomists tell us that there are in the human ear certain rudimentary muscles which seem to indicate that at one time in his history man had the power of moving his ears much in the same way that the horse and many other animals now have, and this opinion is strengthened by the fact that some few human beings still possess a slight power over these muscles and can give a little movement to their ears either backwards or forwards, and also that here and there the internal folds of the ear present a point which looks very like having been the apex of the ear when it assumed a somewhat different form from that which it now takes. Now supposing for the moment that what I am about to say is worth hearing (a supposition which I personally cannot make), it might, considering my weak voice, be an advantage to you if these rudimentary muscles in your ears were in a more developed state, so that you might convert your ears into a trumpet shape and turn them in the direction of my voice. Of course I exclude all ladies present from any such suggestion, as nothing could possibly compensate them for the disfigurement which would be occasioned by such an use of their ears.

The fact I have just mentioned is a natural introduction to the subject upon which I am allowed the privilege of talking to you for ten minutes this evening—that subject is Evolution, and the fact I have stated is one of those used by the advocates of evolution in support of their theory. There is no disguising the fact that the theory of evolution is one full of difficulties, but it is much more full of prejudices, and probably the subject is one about which more is said without the speaker knowing exactly what he is talking about, than upon any other subject which just now is taking up public attention. It is, however, not my intention in the short space allotted to me here to attempt to set forth all the theory of evolution, indeed, I am not competent so to do, not having devoted sufficient time to its study, and probably not having the skill if I had the time to unravel its mysteries and give anything like a clear and understandable exposition of the system. I have a much more modest end in view, namely, to notice three of its main doctrines, to glance at some of the uses which are being made of the system by some of its advocates, and to draw a practical conclusion therefrom, having a bearing upon the Society which has invited you here this evening.

But before doing this allow me distinctly to say that I do not intend to give any opinion whatever upon the truth or otherwise of evolution, it would be presumptuous in me to attempt such a thing. I am a simple enquirer ; to me evolution presents itself as a theory well worthy of the investigation of every intelligent man. I am only at the threshold of it, and cannot pretend to be a judge, except in so far as may be necessary for my personal guidance.

The moot idea of evolution seems to me to be over-production, in the sense that an enormous number of life germs produced by nature cannot in the nature of things reach maturity. In the organic world, wherever we look, we find large numbers of life germs being constantly produced, the greater proportion of which never can live out the term of their natural life, and comparatively few of which can live even long enough to reproduce their kind. The reasons for this are not far to seek. For one thing there is not usually sufficient food for them all. Again all are more or less subject to attacks from enemies, many of them serving as food for a higher organisation than themselves; and climate being also a very destructive influence amongst them. From these and other subordinate causes arise what the evolutionists call the struggle for existence—a struggle of terrible appearance, when looked at apart from its consequences. The effect of this struggle, so evolutionists say, is that only such of the plants and animals as are the strongest and healthiest of their kind, and best adapted to their environment, survive ; and by means, and because of this struggle, the species, whatever that species may be, is safe from deterioration and brought to a far higher state of perfection than it would otherwise arrive at.

If Malthus be right, I suppose the time will come when this delightful state of things will prevail amongst human beings, but, perhaps some of you will think that as to human beings, the struggle for existence is already great enough, quite sufficient to induce every thoughtful man to make the best of himself—physically, mentally, and morally—and so help to produce the much desired-improvements in his fellows and descendants without the necessity for the introduction of the more formidable agencies to which I have alluded.

Working by the side of this " struggle for existence " is another law, namely, that of inherited qualities. Every living thing seems to bring forth after its kind—one blade of grass is very like another of the same kind—one sheep is very similar to another. Every gardener and every farmer knows the tendency of plants and animals to inherit the good or bad qualities of their respective parents ; hence if a plant or an animal either inherits or acquires qualities which make it in any way superior to others of its kind, that plant or animal will in all probability survive its fellows and transmit those qualities to some of its descendants, and thus such qualities will be preserved, but whilst this law of inherited qualities is true as a general statement, it is qualified by the fact that the descendants of a plant or an animal are never exactly like their parents—the son although often very like his father, is never so much so as to be mistaken for him, and this is so in all living things,—there is a constant variation in character and qualities in what seem to us to be subordinate things. Some of these variations are beneficial to the plant or animal, others are hurtful. Of course the hurtful ones tend to the destruction of those possessing them. whilst the beneficial ones give their possessors superior advantages in the struggle for existence, and so by virtue of these two causes--the inheritance of good qualities with a variation in favour of the individual—the individual fortunate enough to possess them must of necessity overmatch all others of its kind, and if any of its kind survive, it will be among the number--there will be, as the evolutionists say, a survival of the fittest.

These I take it are the main foundations of evolution. There are, of course, a large number of subsidiary doctrines, and the system as a system is growing almost every day ; but I think I have stated enough for the purpose I have in hand. Now this theory of evolution seems to be finding favour in the minds of our leading scientific men. I find Professor Wyville Thompson writing thus in his Depths of the Sea :—"I do not think that I am speaking too strongly when I say that there is now scarcely a single competent general naturalist who is not prepared to accept some form of the doctrine of Evolution." Again, Professor W. Stanley Jevons, in his Principles of Science, says :—"The theories of Darwin and Spencer are doubtless not demonstrated ; they are to some extent hypothetical, just as all theories of physical science are to some extent hypothetical and open to doubt. But I venture to look upon the theories of evolution and natural selection in their main features as two of the most probable hypotheses ever proposed, harmonizing and explaining as they do immense numbers of diverse facts. I question whether any scientific works, since the 'Principia' of Newton, are comparable in importance with those of Darwin and Spencer, revolutionizing as they do all our views of the origin of bodily, mental, moral, and social phenomena."

Seeing, then, from the testimony of these two competent witnesses how wide an acceptance the theory is receiving, how is it being used? By some in a very mild way—merely making the word species a more pliable word, and using it to cover much more than it did heretofore, and so simplyfying classification. But others go much further than this, and make the theory account for all living things (except man); that is, they say that all living things have come from one simple living germ, which simple living germ, by virtue of the influence of the laws of evolution, has evolved all the varied forms of things we see in Nature. Others again shut out the creation of the living germ, and lay down spontaneous generation as an all-sufficient account of the origin of life and the laws we have been considering as an explanation of its variations.

Had this been all I should not have called your attention to this matter this evening; it might well have been left to those who take pleasure therein, but the more advanced disciples make evolution account for everything, not only man as an animal, but man as a speaking, reasoning, and moral creature, a view of it which comes close home to us all, tending, as it does, to sweep away what some of us hold to be very precious, and which certainly ought not to be parted with by us without good cause shown. Now seeing that this theory is so important in its consequences, and is gaining such ground, what attitude ought we take up with regard to it? It seems to me that it is one of those things that we cannot simply ignore, that is, if we are thoughtful men. We want to get at the truth about all these higher problems dealing with our "whence" and "whether"; whether we will or not the time is coming when some thought and attention will have to be given to the subject; it is pressing on, its advocates have just started an able quarterly, the avowed object of which is to base psychology upon physiology; it comes before us with all the power and fascination of what it calls, and which to a large extent undoubtedly are, verifiable facts as its proofs. It will be seen, on examining it more fully, that a large number of its proofs are drawn from natural phenomena.

How many of us have a sufficient acquaintance with these things to be able to understand whether the facts are correctly stated, and more especially whether the right deductions are made from them? I fear but few, and I want you to join our Society, and be real workers therein, as it seems to me extremely desirable that all truthseekers in the present day should compel themselves to spare some portion of time at least to a study of nature and natural phenomena, and especially in their broader and more philosophic aspects, and thus prepare themselves to test, consider, and properly weigh the evidence brought forward in support of a theory which, if it turn out true, we must, of course, accept; but if we can detect mistakes in its facts, or flaws in its reasonings, we shall most of us be only too glad to hold by the faith of our fathers and retain beliefs and hopes for here and hereafter, which have been a source of solace and comfort to the generations that have preceded us, rather than to let them go the way of worn-out superstitions.

MR. E. MOORE ON "BUTTER AS A NUTRIMENT: ITS SOURCES AND ADULTERANTS."

I suppose that, if the question—"Why do we eat butter?"—were asked, the natural reply from most persons would be, "Because we like it;" and yet, unknown to ourselves, perhaps, we are following the inexorable law of demand and supply from our bodies in the daily introduction of fat food necessary for the reparation of the system by supplying carbon lost through respiration. Anyhow, in some form or other, it is essential to our physical well-being that some daily modicum of fat should be presented to our digestive power; and butter fat represents, to by far the larger portion of our population, the most natural, as well as the most agreeable, form in which to take it. With bread, butter, and milk, an infant, when dissevered from the natural fount, will grow, forming fat, flesh, and bone. (The brain power, however, has been ascribed to phosphorus by learned scientists—hence, possibly, the disposition of clever children to suck lucifer matches—this by the way.) The consumption of butter, then, as an element of nutrition, is very great, and its cost seems likely each year to become greater. As an article of diet, the value of butter is two-fold; first, from its very nature—and I allude essentially to true good butter in contradistinction to the heavily-salted and partly rancid samples; its palatability recommends it, with a due proportion of starchy food. Secondly, that, as a hydrocarbon its action is considerably more energetic than starch or sugar as an aliment; and also in the process of digestion. The pancreatic fluid exercises its special influence in the utilization of fat food, assisting not only in the transfusion into blood, but supplying the requisite amount of fat to the different tissues of the body.

The necessity for fat, varied by climate and circumstance, is aptly illustrated in its extremes by the hard-working ploughman, with his fat pork hunched on bread, in our temperate zone; the blubber and oil feeder of the Arctic regions; and the sparing use of ghee, a clarified butter used with rice, by the slight Hindoo of the tropics. It will, however, be borne in mind that both sugar and starch are, in process of digestion, fat formers; a fact sufficiently illustrated by Mr. Banting in his mode of treating extreme obesity.

Butter consists of the fatty portion of cows' milk, in which it is suspended in the form of minute globules. The process of creaming allows the milk to remain undisturbed and separates the layer formed. By violent agitation, the act of churning breaks up these globules and a fatty mass results, which invariably contains some casein or curd, with milk-whey or water. The necessity for rigid cleanliness in the appliances used is evidenced by the extreme care shown in all well-kept dairies. Butter varies in colour and flavour; depending on season, food, breed, and the health of animals. It is singularly susceptible of acquiring flavour from extraneous sources. The quality and character of the food thus exercises a prominent feature in its manufacture, as much made in those wild districts, where the grazing is essentially different from our rich meadow land, is almost uneatable to ordinary palates—its odour and taste being absolutely nauseous. This is shown more particularly in butter made in the extreme northern portions of Europe, such as Iceland and Lapland.

The worst feature, perhaps, in cow feeding, is the artificial stimulus given by the excessive use of partially exhausted brewers' grains to the lacteal secretion of the animal. I myself but lately had a sample of milk brought to me distinctly tasting of castor-oil. The cause was clearly traced to the use of rancid linseed-oil or cotton-seed cake. Butter also made from the milk of cows fed largely on recently irrigated sewage grass speedily acquires rancidity and *mal odeur*, and will not keep as fresh butter. But, as the great supply of butter in bulk is a collection and amalgamation of different herds and small lots of cattle, the particular characteristics of the animals are blended into one. The marketable value of different brands is maintained evidently by the care in collection as well as in feeding and manipulation. The Norman butter-buyer, sitting in the receipt of the produce of scores of small dairies handed to him on the market day, selects with an instructed eye and creates half-a-dozen at least of different value out of the many offered him. In our own county, the produce of Mr. Bull, of Hurst, ranks special even among good butters.

The constituents of butter are fat, curd, and whey, with small quantities of added salt. The amount of water should not exceed seven or eight per cent. ; and the salt is excessive in fresh butter if over two or three per cent. An excess of curd in butter produces a flavour too much like cheese. I have had samples of butter show an amount of water equal to eighteen per cent. ; the result, not only of want of due pressing, but of positive addition as a make-weight. And such butters would yield 70 instead of 80 per cent. of true butter fat. I may, perhaps, allude to the singularly variable proportion of butter in the milk of domestic animals ; but this must be taken apart from the quantity yielded by each. The mare gives 90 grains to the pint of milk ; the ass, 185 ; human, 266 ; cow, 320 ; sheep, 513 ; goat, 568 ; sow, 583. I am credibly informed that this country consumes far more butter for each head of the population than any other. Day by day the fixed habit of life requires that the pat or the pound should find its place on our table—the weekly consumption being equal to above five ounces for each individual. And it must be borne in mind that there are at least four months in the year when butter producing is infinitely below the butter demand. This used to be met by the large store of preserved and salted butter ; but, alas ! pleuro-pneumonia and rinderpest, with an increased daily demand, have materially reduced this storing. Good salt butter rules high ; Dorset is a luxury ; and fresh an absolute extravagance. Of late years considerable exertions have been made by merchants to open fresh sources of supply. They have sought for, and found, many such, available only by those marvellous means of transport the age is remarkable for, and by which one locality is made to supply the needs of another. I am enabled, by the courtesy of a merchant, to illustrate samples of butter from many parts, and it will be interesting to know how far and wide the sources lie. We have butter from America, from

Canada, from Italy, from Sweden, from Denmaak, Spain, and Austria. It is true of the saying as regards tea and sugar, that the world must be compassed before the washerwoman can sit down to breakfast; and the butter at my table is now nearly as great a traveller. The export of butter from Denmark to our Indian Empire in tins has become a large trade. Considered chemically, the fat of butter has a more complex constitution than most other fats. Its main peculiarity is in the substance butyrin, to which butter owes most of its peculiar flavour and smell; and this it is that distinguishes it from other fats. By oxydation, it yields butyric acid, remarkable for its strong rancid odour; and to the oxydation of this and other elements is due the tendency of butter to become rancid long before such fats as suet for instance.

I think when I mention the names of the various substances occurring in butter, you will be satisfied with its chemical variety. They are—Palmitin, stearine, olein, butyrin; with four fatty acids—Butyric, capronic, caprylic, and capric; the latter being named from their similarity in odour to that of the goat secretion. In cheese making, the enclosure in the curd of a proportion of butter fat represents the difference between a rich and poor cheese—such as Cheddar and Dutch. In the first place, pains are taken to ensure the presence of a large proportion of butter; in the latter, pains are taken by the thrifty people to exclude it. They market the butter alone, or, as an admixture. Dutch cheese consists almost entirely of curd, nutritious enough in its nitrogenous power, but awfully difficult and slow of digestion—to those unprovided with gizzards. The rapid melting of butter in the mouth is indicative of a lower melting point than that of other fats. The clinging sensation of the fat of a half-cold boiled leg of mutton has been familiar to most of us in our boarding school dinners, if we were so unfortunate as to be among the last helped. The different melting points of various fats are—Butter, 35 deg. centrigrade scale; ox fat, 48 deg.; mutton, 50; lard, 42; tallow, 62; cocoa butter, 35; and butterine, 34.

The last of this list is a creation essentially born of our time and the scarcity of true butter fat. It is sometimes fairly sold for what it is, for what it is worth; not unfrequently for what it is not; and it also forms a basis of adulteration with butter. Years ago, one heard of London and Ostend butter. We knew that butter did not grow in

London; but, latterly, we have had a better instruction, and the Thames mud is accredited as the source. Putting such statements on one side, what is likely to be the truth? All the world over, waste fats occur, and are collected. The candle, which has now yielded to the advance of gas and petroleum, used to absorb most of these; but now, the exigencies of a butter-requiring public must be supplied in some form. If it be true that we are ignorant of the precise nature of many of our beverages, it certainly is true on this butter question. I have here a sample of butterine. The appearance recommends it; its colour is delicate; its spreads smoothly; and melts lightly in the mouth; is nearly tasteless. But its odour is scarcely identical with that of true butter. Now it must not be supposed that so nearly a perfect imitation of butter is the result of any crude process, such as the admixture of beef or mutton suet, and simply a melting and colouring to pattern. It is more than possible that the original fat from which this is composed was a waste fat in some repugnant form, clarified again and again by jets of steam and filtration; the low melting point being arrived at by the judicious admixture with it of an exact proportion of olein, obtained from lard; and the colouring the same as that used in most dairies; the mass being eventually beaten up with rich milk. The one thing requisite to complete it is wanting—that delicate odour characteristic of real fresh butter.

I have found no adulteration in the low qualities of salt butter other than an excess of water, and the evil odour acquired by age; but there is no doubt that substances of this nature enter largely into the composition of those highly-prized fresh butters demanded at this time of the year, when dwellers in cities expect the fields to be green, and the cows feeding on the fragrant grass of the meadow land, while they are dry and in the cattle yard. Many cleverly-constructed compounds, chemically put together, have found their way into the market; and, as it will be noticed that the butterine melts at a point nearly identical with that of butter, to the analyst butter has been a sore trial. He knew from its many physical characteristics, it was not, could not, be butter; but the enquiring mind of the chemist has brought to perfection a process by which this impostor may be convicted among others of a like nature. And yet it is only fair to state, considered purely as nutriment, this substance might and should have its honest place amongst us at its true and honest price. The fat the candle does not now burn would be burned with revenue in the human

system if the prejudice of idea al
it may yet honourably take its
attempts so many are engaged i
cheap food for a struggling popul

It is not given to us by the la
The utilization of such substance
food is at least a gain upon its wa
way waggon.

I will close my ten minutes
culinary. It is very desirable to
analogous fats ; as in fish frying
vegetable oils are a far better med
lightly digested becomes a sour
assimilative power of our youth
alike, from the stale penny tart
sausage, gives place, as years r
necessitating care for our stomach
in our kitchens.

MARC

ORDINARY MEETING. — ICELAND, ITS PHYS TERISTICS, &c.

The lecture that evening was
characteristics. This island, whic
Ireland, was situated, as all kne
Circle. Apart from its historical a
his purpose to consider that eve
the geologist and the physical
northern extremity of the great
extreme west of the Old World,
Mayen in the Arctic Ocean throu
Britain, the Madeiras, the Azores,
of Africa, right away down to th
Cunha, and its equal as a centre o

found amongst the islands of the Pacific Ocean. The peculiar manner in which ice and snow were found mixed up with the igneous productions of its volcanoes imparted a grim beauty to its scenery that we might travel the whole world over without seeing surpasssed. A very short sojourn amongst the weird rocks of Iceland aroused that latent superstition which would lurk in the minds of even the most materialistic, and while we laughed at the mythological credulity of the ancient Icelanders we could not help acknowledging that a more fitting place to create an implicit belief in wraiths and demons could not possibly be found, from the elf and pixy dancing amongst the timid flowers whose bright eyes peeped from sheltered rocks in ancient lava streams, to the hobgoblin and the ghoul moaning and shrieking and performing their nameless deeds upon blasted peak and barren mountain-tops, where fire strove with frost.

This remarkable little island was colonized 1,002 years ago by Norwegians, though its earliest settlement was involved in some obscurity. It afterwards became subject to Denmark until the year before last, when it received its legislative freedom. The Icelanders were upon the whole a harmless, struggling race, and like most other nations that had been unable to draw upon the arteries of other countries for renewed vitality, were encumbered with that contentment which, however conducive it might be to domestic ease, was fatal to advancement. The last twelve months, however, had introduced the element of enterprise which before was only conspicuous by its absence. This might result from their newly-acquired liberties or the reflective influence of emigration; at any rate it augured well for Iceland, whose emigrants had already shewn that the Icelander contained a good deal of the right sort of stuff in his composition. Pre-eminently perhaps in the Icelander's character stood love for his country. It was a remarkable fact that the more barren and unfruitful a country was, the stronger seemed to be the attachment and love of the sons of its soil. That trait appeared very strongly in the Icelanders' national song, the first stanza of which runs thus—

"World old Iceland, beloved fosterland,
As long as the ocean girds our shores,
As long as lovers for their sweethearts sigh,
As long as the sun shines upon our mountains,
Thy sons shall love thee."

The climate of Iceland was very uncertain, but it was much milder than might be expected from its latitude. This was doubtless owing to its insular position, and the influence of the Gulf Stream, one arm of which washed its southern shore. The summer began in June, and ended in September, and during those months the climate was much similar to that of the North of Scotland. The rainfall, especially in the south of Iceland, was very great during the summer, but thunderstorms seldom occurred, except in the winter. Upon the mountains the climate was still more variable, and he had sometimes experienced a variation of sixty degrees between day and night upon the snows of the Vatna Jökull, at the height of some 4,000ft. above sea level. But few vegetables could now be grown in Iceland,—a modicum of potatoes, turnips, radishes, and cabbages alone eking out a struggling existence against an adverse climate, and seldom attaining to what we should consider maturity. The trees of Iceland were mere bushes of birch, willow, and a little ash, and even these were but rarely met with. The chief exports of the country were fish, wool, horses, sheep, and Iceland spar; but it was to be hoped (now the sulphur mines in the north of Iceland were about to be worked) that in the course of a year to these might be added sulphur. The imports were all the necessaries of life and a good many of its luxuries.

So much for Iceland itself; he would dwell no longer on its history, people, exports and imports, but forthwith consider its physical characteristics; these might be defined as the volcanoes of Iceland and their product, the hot springs, the Jökulls or ice mountains, and their effects upon the climate. Iceland contained no fewer than 22 mountains that had been witnessed in active eruption during historical times. The best known volcano was Hekla. This remarkable mountain rose directly from a plain that had been devastated by its repeated eruptions. As the mountain was approached from the northwest its form appeared to be that of an oblong cone; it was about 20 miles in circumference, and 5,000ft. in height; it was capped by three smaller cones, the product of recent eruptions. Its craters were all upon the west and south-west sides, and most of its lava streams had flowed in that direction. The next best known of the Içelandic volcanoes was perhaps Katlugia, which had erupted no less than 15 times since the year 900. It now presented nothing but a deep valley filled with snow, cutting into the very heart of Myrdals Jökull; it was one of the largest examples of breached craters in the world. The principal phenomena attending eruptions of this volcano were stupendous floods of heated water, and the prodigious quantities of sand ejected. It had, he believed, never been known to produce lava, but upon the base of the mountain he found numerous ancient lava streams, proving that at one time Katlugia was no exception to its neighbouring volcanoes. The floods from Katlugia during eruptions had often submerged a district of 280 square miles, continuing sometimes for days, in spite of the rapid outflow to the sea. These floods were produced not only by the melting of the snow at the time of eruption, but in all probability by the bursting of large cavities in and beneath the mountain, in which water might have been for years accumulating. This aqueous phenomenon was, however, by no means peculiar to Katlugia, although it occurred on the largest scale, for during the 13th and 14th centuries all the volcanoes in the south of Iceland erupted water.

The most extensive eruption that ever occurred in Europe during historic times proceeded from the south-west portion of the Vatna, named the Skaptar Jökull. This volcano had only been known to have erupted upon that occasion, viz., A.D. 1783, when it produced two of the most extensive lava streams in Europe, of which he would speak presently. The volcanoes which erupted so violently in the beginning of the present year, and one of which wrought such damage in the north of Iceland were—The Oskja-già (or the chasm of the oval casket) situated in the Dyngjufjöll mountains upon the north of the Vatna, and a chasm some twelve miles in length which opened in the Myvatos orœfi (or sandy desert of Myvatos). The first of these was a triangular crater over five miles in circumference, formed, he should be inclined to think, by three smaller craters blowing into one another. It was situated in the south corner of the plain of Askja, in the Dyngjufjöll mountains. This plain was situated at the height of about 3,000 feet, and was shut in on all sides but one by semi-detached sections of mountains, many of which had broken out in ancient times, and by their insignificant lava streams had helped to swell the wide-spread lava desert of the Odathahraun. The crater of Askja-già was bounded on the north by a wall of rock which descended in a sheer precipice of some 200 feet from the level of the plain of Askja. It was shut in upon the east and west sides by lofty mountains, some of which rose to the height of 1,000 feet above the plain of Askja; they appeared shorn of their inner faces by the violence of the eruption, forming perpendicular cliffs of great height. These were rapidly falling in and had formed in several places steep slopes of pumice and debris, which it was quite possible to descend. All access to the floor of the crater, however, was prevented by an interior rim of precipice immediately at the base of these heights. Three separate lines of fissures, pits and irregular openings, diverged from the centre of the crater to the south, north-east, and north-west respectively, and, when he was there, still continued to erupt vast volumes of steam, a dark granulated fatty earth, and a little water. It was from this volcano that all the pumice was ejected which had fallen in a band of ever-extending radii eastward from the volcano to the sea-shore, destroying six farms in its course, and injuring others. Considerable streams of water had evidently flowed from this crater, and this was the more remarkable, as it was neither a glacial nor a snow-capped mountain. This water was probably derived from the melting snows of the Vatna Jökull which had found its way through the loose and cavernous ground (principally sand and lava) to the chimney of the volcano, where it had accumulated. The fissure in the Myvatos orœfi, which he had before mentioned, opened slightly before the eruption of Oskja-giá; from it had flowed a lava stream about 13 miles in length, and varying from one to three in breadth. The various eruptions from this fissure had cast up six or seven subconical mounds, one of which he saw in violent eruption last year; it was then about 150ft. in height. The ground in the immediate neighbourhood of this crevass was greatly fissured and dislocated, and an extensive subsidence had taken place around its southern extremity.

Time would not allow him to dwell any longer upon the volcanoes of Iceland, and he would only remark that their general characteristic was lack of height when compared with the volcanoes of other countries, and their irregular occurrence. First they broke forth amid the snows of lofty Jökulls, then from beneath mountains that for ages had stifled volcanic energy, then in the midst of plains already desolated by prehistoric eruptions. This eccentric shifting of volcanic foci was most probably the result of the numerous fissures and cracks in the superficial rocks of Iceland that had been formed by the various earthquakes which from time to time had shaken the island to its very foundations.

He would now briefly consider the products of these volcanoes, which almost entirely constituted the rocks of Iceland, and indeed all the Icelandic rocks that he had met with had been either igneous in their origin or derivatives from igneous rocks. They might divide the productions of the Icelandic volcanoes into two classes. First, those in whose formation water had played a prominent part—these they might call the agglomerates or tuffs; and secondly those which were entirely of igneous origin, in other words, the lavas. The first of these, that is the agglomerates, were formed by the bursting of mountain lakes and the sudden melting of the frozen covering of snow-clad mountains during periods of volcanic eruptions, which caused an overwhelming flood of heated water to rush down the mountain's side. This, licking up the sands, the fragmentary *débris*, and whatever accumulation it might meet with in its course, precipitated itself in a terrible and heterogeneous avalanche upon the plains below, forming hills of steaming agglomerate, and filling up whole valleys with a seething paste. But the mountain streams and atmospheric elements collected together through the long periods precisely the same constituents as formed the agglomerate of more terrible manufacture. The mountain stream brought down grain by grain the sand, the constituents of disintegrated rocks, and piece by piece the fragments that had been split off by the action of the frost from overhanging peaks. The mountain stream worked slowly, but as surely as the dread avalanche of fire and water. Thus even in the very home of convulsion we found the gentle and constant forces of Nature vieing with the terrible, and showing that the peaceful and sustained efforts of Nature did as much towards altering the face of the earth as the most fearful convulsions; but as a rule, their effect differed in this way, the peaceful forces of Nature gave us our beautiful scenery and smiling landscapes, while the terrible gives us the awful magnificence and grandeur of desolation so pecular to volcanic scenery.

The second class of Icelandic rocks was the lavas. These occurred either as stony streams that had flowed from volcanoes, or as pummice, which had been hurled high into the air, and fallen in a destructive shower of vesicular cinders. There was another class of lavas, namely, the glassy variety, or obsidians. These, on account of the extra amount of silica they contained, and in all probability the different circumstances attending their cooling, formed a volcanic glass, occuring in glassy or semi-glassy masses, also as a beautiful vitreous pummice, such as that which was ejected from the volcano of Oskja-gjá last year, specimens of which were upon the table before them. Of the stony streams of lava they had two very good examples; first, the huge lava streams which flowed from Skeptar Jökull in 1783, being 50 miles long and 25 wide, and the other 40 miles in length and 7 broad, being in some places 500 feet in depth. It had been computed that the entire mass exceeded in bulk that of Mont Blanc. This lava was balsatic and highly ferruginous, and impregnated very strongly the waters of the river Eldvatn, which flowed through it. The second example was the lava stream which had flowed into the far-famed valley of Thingvilla, wherein the Althing, or Parliament, of Iceland used to hold their meetings, and the wonderful rifts of the Almanna-gjà and the Raven's-gjà occurred. At some remote period of the geological history of Iceland a large river of lava flowed from Mount Skjaldbreith, which was about 30 miles distant, into the valley of Thingvallir. A crust, of course, soon formed on the surface, and, upon the cessation of the eruption, the still liquid lava at the bottom of the stream continued to flow into the deeper parts of the lake, which occupied the S.E. end of the valley of Thingvallir, leaving the unsupported crust, which was now of great thickness, to sink down to the present level of the valley, occasioning lateral rifts upon either side of the stream—viz., the Almanna-gjà on one side and the Raven's rift upon the other. The valley of Thingvallir was likewise traversed by many smaller fissures and crevasses, which in many instances enclosed and almost insoculated large masses of lava; the Loghsberg, or "hill of laws," was such an island of rock, and was rendered inaccessible except at one point by deep yawning crevasses. It was on account of these natural fortifications that it was chosen as a forum for the ancient Court of Althing, which assembled there once a year. Such were the monuments of Iceland, which took the place of the ruined castles and abbeys of other countries, simply the rude rocks of Nature ennobled by brave deeds of history or some touching romance of love.

They next came to the hot springs of Iceland. The chief of these, *par excellence*, was, of course, the Great Geysir. It had been so often described and redescribed that it scarcely needed a remark from him. Professor Forbes calculated its age, from the thickness of siliceous scinter which surrounded its basin, at 1,000 years. The Great Geysir was surrounded by numerous other springs of all temperatures and sizes, whose deposits differed according to the character of the rocks through which they passed. There were numerous hot springs scattered about in various parts of Iceland, some of which owed their existence to earthquakes, which instantaneously called them into being—in 1339 a hot spring 60 feet in diameter suddenly opened at Mosfell,—and during the earthquakes which preceded the great eruption of Skaptar Jökull, in 1783, no less than 35 new hot springs made their appearance.

He would not dwell longer upon these interesting phenomena, but turn their attention to the huge ice mountains or Jökulls of Iceland, which constituted such an important feature in the physical geography of the country. The principal ones were the Vatna, Arnnafells, Hoss, Langs, Myrdals, Godalouds, Eyjafjalla, Dránga, and Glámu Jökulls. He would try and form some idea of by far the largest of these, namely, the Vatna Jökull, which, until recently, was almost a "terra incognita," and until this year had resisted all attempts that had been made to cross it. It was the very best example that he could lay before them, as it displayed all the phenomena of the Icelandic Jökulls on the most extensive scale. The Vatna Jókull was a vast accumulation of volcanoes, ice, and snow, comprising an area of over 3,000 square miles. It was for the most part surrounded by a wilderness, formed by the destructive outbursts of its volcanoes and the constant drifting of the glacial torrents which flowed from its melting snows. Never should he forget the aspect of this mighty frozen desert when he assailed it last June. They had reached the point where the rocks terminated, and the external snows of the Vatna commenced. As far as the eye could see was one lifeless, pathless, wilderness of snow, destitute alike of animal, insect, or floral life; their footsteps gave no sound, and their very voices seemed strange in this drear solitude, the deathlike stillness of whose frozen wastes was broken only by the howling of the storm or the outbursts of a volcano. This journey across the Vatna Jökull from the south to the north of Iceland occupied 16 days, twelve of which were spent amongst the regions of perpetual snow. The Vatna Jókull and its immediate surroundings constituted the most lofty portions of Iceland, and he believed the oldest, for they found lava streams which had flowed from its volcanoes in a state of ruin and decay unequalled in any other part of the country; and, again, they found it bounded upon the south by sea cliffs that were washed by pre-historic oceans when many other parts of the island must necessarily have been under water, unless very serious depressions had taken place since the waters which washed the south outlying hills of the Vatna receded to their present limit. The Vatna Jökull comprised by far the most important mountain section in Iceland, and a far greater area was covered by its snows than could be occupied by the sum of all the remaining snow-clad mountains in Iceland. As might be supposed, at least half the river water of Iceland flowed either directly or indirectly from the Vatna Jökull, either issuing in torrents from the extremity of its glaciers, or after filtering for long distances through the loose and cavernous ground, appearing as land springs at a lower elevation.

The rocks of the Vatna, as far as he had had an opportunity of judging, were purely and simply the product of this very remarkable cluster of volcanoes, which had piled up layer after layer of ash, sand, and agglomerate, until a mountain heap was formed of such a height that it allowed snow and ice to accumulate upon it to such an extent as to render the summer's warmth quite inadequate to remove it. This vast snow pile then grew of its own accord, and glaciers commenced to creep down the sides of the barren mountains upon which it rested. Volcanoes continued to erupt, but the effect of their fires upon the accumulating snow must have been purely local and limited in the extreme, for volcanic productions were the worst possible conductors of heat, and he should imagine that a lava stream, unless it were of gigantic proportions, conducted itself beneath the profound snows of the Vatna, much as a lava stream would beneath the sea, without producing any very violent commotion. Thus this vast mountain mass was accumulated, growing with each succeeding winter and each eruption. The Vatna Jökull rose by a very gradual slope upon the south, and it was not until more than thirty miles of snow fields had been traversed that the highest part of the Vatna, viz., 6,150 feet, could be reached from that direction.

He had at present omitted any mention of the snow line in Iceland ; this was on account of its variable nature, incidental to local causes. Thus upon the Vatna we had the snow line much lower upon its southern than northern slopes, the cause of which he would consider presently. Of late years the volcanic forces of Iceland appeared to have retreated to the Vatna Jökull and its immediate neighbourhood, and volcanic eruptions had been witnessed in force in several directions. The Krerktjall they found to be smoking and Oskja-gjà could only be regarded as a lateral crater of the Vatna, and, he doubted not, had they been favoured with better weather, he should have found many other eruptive rents; but so rapid was the accumulation of snow upon the Vatna, and so bad a conductor of heat were all volcanic eruptions, that traces of volcanic eruption were very soon obliterated. As might be supposed, such a prodigious accumulation of ice and snow as the Vatna Jökull produced a very sensible and marked effect upon the climate of certain parts of Iceland. It had this effect—it deluged the country to the south of it with rain, and gave to those districts which lie to the north of it a happier climate than they would otherwise possess. The snowy heights of the Vatna attracted to themselves the aqueous vapours which travelled northwards from more southern latitudes, depositing them upon their broad shoulders in the form of snow and hail, and refrigerating and drying the vapours which travelled across their snows, thus rendering the south wind a wet one in the country to the south of the Vatna and the north wind a dry one, whilst in those districts which lie to the north of it the reverse was the case. And since by far the greater part of the aqueous vapours which reached Iceland was borne thither from the more readily evaporating waters of southern oceans by that bugbear to travellers in the south of Iceland—the southerly wind—they saw at once why the snow line was lower upon the south than the north of the Vatna Jökull. When they inspected the glaciers which fringed the south of the Vatna Jökull, they found they had decidedly advanced; indeed, at one point, so much so, as to almost destroy communication along that part of the south shore. Upon the north they found that a huge tongue of glacier had flowed down full ten or twelve miles beyond the utmost limit assigned to it by Gunlaugson some 40 years ago, while the route traversed by that enterprising man was completely overrun by the ice, and the traditionary road of the Vatna Jökull's-vorgr was now amongst the high snows of the Vatna.

Icelanders, as a rule, were loth to admit the advance of their glaciers, and vainly appealed to striated rock at much lower altitudes than most of the Icelandic glaciers of the present day, and to moraines stranded upon the plains beneath some of the principal mountain sections, but since it was impossible to say when these rocks were scratched, or even whether the very rocks to whose striæ they so confidently point were not erupted long before Northern Europe and America disappeared beneath the ice and snow of the earlier glacial period, what was the use of such evidence? The very moraines might have been produced by the glaciers which had strewn even our own country with erratic boulders and glacial *débris*. Again, it was no uncommon thing in Iceland for huge masses of glaciers to slide down the mountain side during periods of eruption, scratching the harder and furrowing the softer rocks in their progress, and leaving heaps of *débris* in no way distinguishable from terminal moraines. These facts were rather startling. True, the glaciers of Iceland might, and, no doubt, did ebb and flow, but they gained upon the whole, and never would increase to that extent was not the annual accumulation vastly in excess of the waste. This might be due to a cycle of unpropitious seasons. Possibly. But they found this advance of northern glaciers was not peculiar to Iceland. Dr. Nordinskjold had proved a considerable advance in the glaciers of Spitzbergen; Greenland gave us the same intelligence. This seemed to point to something more than a local advance, compensated for by a retreat in other places. It was too rapid an advance to be accounted for by astronomical causes. But could not they suggest some comparatively slight physical changes which might account for it?

Granted, that above a certain latitude the earth only received as much heat during the summer as it did during the winter, and that in one winter it would accumulate just as much snow and ice as the summer's heat would suffice to melt, if it were all employed for that purpose. Now, they were perfectly aware that snow and ice having once accumulated, a greater part of the succeeding summer's heat would be reflected back into space and not employed in melting the snow and ice, while the aqueous vapours condensing above it would screen the snow from solar influence. Thus a new glacial period would creep upon us, heralding its approach by an advance band of low temperature of its own production were it not for the warm oceanic and atmospheric currents, the beneficial influence of which we had only to look at the varying temperature of many localities in similar latitudes to appreciate.

A great alteration in temperature and climate would certainly take place, supposing any variation should occur in the direction of these currents—in the Gulf Stream, for instance. Supposing that its waters instead of reaching so far north, were deflected southwards, then not only would Arctic climates and Arctic ice be less affected by it, but the deflected stream would heighten the temperature of the waters of lower latitudes, and cause an increased evaporation; consequently there would be an increased condensation upon northern mountains and Polar shores, and an increased reflection of the succeeding summer's sun. It was rather a curious fact that less American driftwood had been brought to the northern shores of Iceland during late years, and an increased amount had been cast upon its southern coast. This little fact of course proved nothing in itself; but when we saw northern glaciers advancing to the extent they had done one naturally asked the reason. Astronomical causes must be put on one side, for the glacial advance was too rapid to admit of that solution. But if northern glaciers continued to advance it would be a matter of some interest if we could ascertain whether those mysterious forces which gave birth to the earthquake and the volcano had wrought any alteration in the flow of that guardian angel of the north—the Gulf Stream.

The EX-PRESIDENT (Mr. Haselwood) proposed a vote of thanks to Mr. Watts for his extremely interesting and instructive lecture. As far as he understood them, his arguments seemed to point to the probability of another glacial period, though at a future so remote as hardly to be calculable.

Mr. E. MOORE, from what he had gathered from Capt. Burton's book, looked upon the difficulties in the way of the transport of sulphur as almost insuperable. Perhaps Mr. Watts would be kind enough to tell them what means of transport it was proposed to adopt, so as to make sulphur an article of commerce.

Mr. W. HENTY supposed the fact of there now being a deficiency of warmth in Iceland for the growth of corn was due to the increase of glaciers.

Mr. T. W. WONFOR wished to know whether thunderstorms were as frequent in the northern parts of the island as in the southern? Mr Watts's remarks had cleared up some points in his mind as to the presence of aqueous particles in volcanic products; but he was surprised to hear that such enormous bodies of water were thrown out of the volcanoes. He should feel obliged if Mr. Watts would give some further explanation as to the enormous showers of ash which reached Norway and the Orkneys; and there was room for a few words more perhaps upon the subject of icebergs and the glacial epoch.

Mr. G. D. Sawyer hoped Mr. Watts, in his reply, would tell them a little more than he had done about the inhabitants of the island.

Mr. Dowsett asked for information as to insect life in the island, and he should like to know what was the cause of the Icelanders emigrating, if they were such lovers of their country.

Mr. Welch enquired whether the diseases of the country were similar to those of other cold mountainous countries?

Mr. Watts replied to these questions seriatim. The sulphur mines in the southern part of the island were in a state of hopeless standstill; but those in the north might, he thought, be worked so as to benefit the country and prove remunerative to the company which had undertaken to work them. In the present position of the company, perhaps, it was scarcely advisable that he should say more upon the subject. Wheat did not grow in the island; but a kind of wild oats did, though the grain it yielded was small and hardly worth speaking about. With regard to thunderstorms, he believed they occurred in the north as well as the south of the island, though they were less frequent in the north than in the south. Although water erupted from volcanoes in other parts of the world, none of them threw out anything like the quantity of water discharged by those in Iceland. It was a peculiar fact that the ash from the Iceland volcanoes generally went in the direction of Norway. Insect life he did not know much about; but he might say that the mosquitoes were a great nuisance, and that several districts were named after flies. There was a lake called the Fly Lake; it was sometimes covered with flies; and sometimes there was not a fly to be seen on it. He had seen the snow blackened with flies, which had been frozen in their flight. A good many Icelanders looked upon emigration as something which tended to the good of their country; but though fascinated with the luxuries of Europe, and quite willing to live there, the Icelander generally expressed a hope that he might die in his native country. Brigham Young was doing his best to foster emigration to the Salt Lake City, and he had three missionaries working in the island during the past summer. The principal diseases of the island were leprosy and tape-worms. Mr. Watts concluded his remarks by an interesting description of some of the characteristic habits and customs of the people.

The lecture was illustrated by a large map kindly lent for the occasion by the Geographical Society, for which a vote of thanks was accorded to them on the motion of Mr. Wonfor, seconded by Mr. Dowsett.

MARCH 25TH.

MICROSCOPICAL MEETING.

The palate of octopus and some young oysters, mounted by Mr. Henry Lee, were exhibited, the latter showing both shells, as were also the palate of squid, the ventral fin of dog fish (squalus galeus), and scales of the rough hound. The palate of the octopus and the palate of a snail were exhibited to shew the difference between the carnivorous teeth of the one and the herbivorous teeth of the other.

Mr. T. W. **WONFOR** exhibited blood discs of the conger snake, which has the largest blood discs at present known; hitherto it was believed that those of the salamander were the largest and those of the musk rat the smallest. Attention was called to the fact that the blood discs differed in form in the different divisions of the vertebrate, and the admirable photographs by Dr. Hallifax in the Society's album of the blood discs of birds, fish, reptiles, and mammals, all magnified the same number of diameters, were cited to show how valuable the microscope was in determining the nature and differences of blood stains.

THE LATE SIR CORDY BURROWS.

The **PRESIDENT** (Mr. J. Dennant) said that since their last meeting they, in company with a large number of their fellow-townsmen, had followed to their last resting place the remains of their friend and

Vice-President, Sir John Cordy Burrows : and it was fit at that, their first meeting after the event, they should take some notice of it. Those whose memory would carry them back a quarter of a century would know perfectly well the value he had been to the town. His public character and work had doubtless kept him a good deal away from the meetings of the Society of late years, yet still they were conscious that he had always a warm interest in its welfare. In fact, they had only to remember that he was one of the few co-workers of the immortal Frederick Robertson in the establishment of the Mechanics' Institute ; that he also took an active part in the Albion Rooms Institution and the Athenæum, and that he had been ever ready to assist Societies that had for their object the advance of general education and the cultivation of literature, art, and science, to know that the Society had, in Sir Cordy Burrows, lost a true friend. Brighton had been ready to acknowledge it ; it did so a very short time since in a very tangible manner, and now it had paid a last mark of respect and given an expression of sympathy with his family by a public manifestation at his funeral. The resolution he had to move was—

"That the Brighton and Sussex Natural History Society deeply deplore the loss it had sustained by the death of Sir Cordy Burrows ; and desires to convey to Lady and Mr. Seymour Burrows their cordial sympathy in their great bereavement."

Mr. T. W. **WONFOR** (one of the Hon. Secretaries) said it was with mournful pleasure that he rose to second that resolution, the more so that for the whole of the time he had been in Brighton, now three and twenty years, he had been intimately connected with the deceased in many works for the improvement of the people. His first connection with Sir Cordy was in the Albion Rooms, to which the Chairman had referred. In that Sir Cordy took a very warm interest so long as it existed ; and when it ceased he was mainly instrumental in keeping together the books of that Institution, thus forming the nucleus of the present Free Library. So strongly did some gentlemen feel the benefit he had conferred on the town by doing that, that five gentlemen met at the home of one whom he saw present that evening, and inaugurated that testimonial which grew beyond any thing they at that time anticipated—a testimonial given to him for his services rendered to the town. Sir Cordy had always wished and urged that there should be a Free Library and Museum in the town, and some would recollect a public meeting at which a terrible amount of dissatisfaction was expressed on the part of some people at the proposition. He should never forget, if he lived for a thousand years, the anger of one man, who wound up a violent speech with this declaration, "Eddication is a cuss." They were beaten; but subsequently at another town meeting they were enabled to carry out all that Sir Cordy had ardently looked for—the establishment of a Free Library and Museum. When elected President of that Society, and when he first took the chair, he said, "I hope to see your library a part of the town library; and you established in the rooms of the Pavilion." He lived to see that wish fulfilled, for it was during the chairmanship of Mr. Alderman Abbey, the present Mayor, that the Institution was opened; and the Chairman met him one day in the building and said, "Cannot your Society make application for accommodation in the Free Library?" That application was made, in proper time it was considered, and one of those who urged the adoption of the report of his predecessor, was Sir Cordy Burrows, who lived to see his wish carried out, and when it was carried out, said, "Well, we have got the only scientific society where it ought to be—in the Free Library and Museum." They were, therefore, apart from what they might feel individually of Sir Cordy, deeply indebted to him for the interest he took in science generally, and the interest he brought to bear on the establishment of the Society in its present *locale*. He could go on telling more of what he knew of Sir Cordy, and the kindnesses he had experienced at his hands, as all men had who had worked for the advancement of literature and science, but he must not take up further time, and would simply second the motion.

Mr. C. F. DENNET wished to be allowed to say a few words. Perhaps there was no one in that room, or in the town, who had during the short period of four or five years had more experience of Sir Cordy in the little ins and outs of life than he had. He came to Brighton a stranger, and was thrown into the society of Sir Cordy, who from the first received him kindly, and, to use an American expression, they had "cottoned" together. From that moment to the day of his death there was a continuous course of kindness shown to him by Sir Cordy; and he was not the only stranger who would be glad of the opportunity to speak in his praise. Sir Cordy had been his medical attendant, and when he had been suffering from drooping spirits, consequent on physical debility, Sir Cordy's cordial shake of the hand, bright smiling face, and encouraging word, had given him new life. In such a manner had he carried sunshine into many a sick room.

Mr. BARCLAY PHILLIPS also spoke highly of the deceased, and confirmed what Mr. Wonfor had said respecting the origin of the testimonial. He had no idea when he invited a few of Sir Cordy's fellow-workers in the Albion Rooms to his house to try and raise a small tribute of esteem for what he had done in saving the Library to the town, that it would grow to such dimensions as it had.

The resolution was carried unanimously.

APRIL 14TH.

ORDINARY MEETING. — MR. F. PHILLIPS, B.A., BALLIOL COLL., OXFORD, ON "THE TIDES."

After alluding to the ideas of the Ancients on Tides, and the maritime discoveries of the 15th and 16th centuries, Mr. PHILLIPS proceeded—It was reserved for the genius of Newton to give the first correct explanation of Tides, and to show that they are as much consequences of his great law of universal attraction as the movements of the planets themselves.

Newton's theory was first published in his Principia in 1668, and may be said to have formed the basis of all subsequent investigations. Physical theories can never represent all the complexities of Nature, but the conclusions deduced from them are none the less valuable on that account. Let us ever bear this in mind when considering the subject before us. We shall have to make many suppositions as to the earth, the ocean, and the movements of the heavenly bodies, which are far from being fulfilled in Nature, but which must be made before we can grapple at all with the problem.

We may, if we please, regard our theories as true of an ideal world, and consider that we are comparing its circumstances with our own.

Let us, then, with Newton, imagine the earth covered with a deep ocean, of density equal to its own and of uniform depth, and consider the tides produced in this ocean by the moon. Were every particle of the earth and ocean attracted by the moon with equal and parallel forces, it is evident that, all the particles yielding equally to the influence of these forces, their relative positions would be unaltered. There would, therefore, be no alteration of the form of the ocean, and consequently no tides.

The moon attracts each particle of the ocean directly towards herself, with a force which decreases (according to a fixed law) as the distance increases; this force accordingly differs both in direction and magnitude for each particle, but the solid earth is also attracted by the moon with a certain force; therefore the difference between the moon's attraction on any particle of the ocean and her attraction on the earth, represents her disturbing force on this particular particle, this disturbing force being different for different particles.

Again: every particle of the ocean is also attracted by the earth and the rest of the ocean, or, in other and more familiar words, it gravitates or has weight.

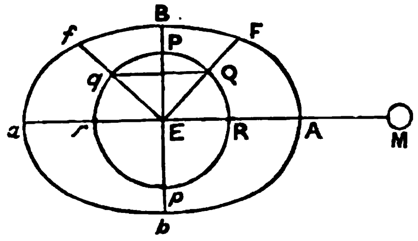
These two attractions are equivalent, by the first principles of mechanics, to a single attraction, or resultant force, as it is termed. Thus we see that every particle of the surface of the ocean is acted on by what we may term a resultant force. But that the ocean may be in equilibrium its surface must be everywhere perpendicular to the directions of the various resultant forces.

Analysis shews that the form of such a surface is a prolate spheroid of small eccentricity (with its axis directed to the moon's centre).

In general language, then, we may describe the form of our theoretical ocean as a slightly elongated sphere.

It is further supposed that at every instant the ocean assumes this form of equilibrium under the action of the forces animating it at that moment.

We are now in a position to trace the variations in the depth of the ocean at any spot in the course of a day.

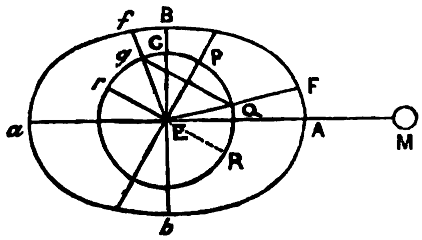


Let *P p* be the polar axis of the earth, and *A b a B* the ocean, or water spheroid.

Let us suppose that the moon M is in the plane of the equator, and that Q is a fixed point on the earth.

When the moon is on the meridian of *Q*, as in the figure, the depth of the water is *Q F*, and it is "high water."

Owing to the revolution of the earth, *Q* is carried eastward, and passes under thinner portions of the water spheroid, till six hours after high water, when it reaches the thinnest part of the shell; it is then "low water;" the depth then again begins to increase, till twelve hours after high water, when *B* is at *q*, and the depth *q f* is equal to *Q F*, and it is again high water. The changes during the next twelve hours are precisely the same as those we have just traced. Thus, in the course of a day of twenty-four hours, there are two high waters and two low waters; and it is further easy to see that the state of the tide is exactly the same at intervals of 12 hours. These are termed the "*semi diurnal tides*."



Next, suppose that the moon is not in the plane of the equator, so that the earth's axis, *P p*, is inclined to the axis, *A E a*, of the water spheroid. Let Q denote the same fixed point (of observation) on the earth. Then we see from the figure that the high water, QF, is greater than in the previous case. The height of low water will be the same as before, for it may be shewn to be equal to BC; it will occur when the moon sets, which in this case will be more than six hours after high water; the depth will then again increase, till twelve hours after the first high water there will be a second high water, but, in this case, much less in height than the first. Similarly the heights of the tide at intervals of twelve hours will no longer be equal.

There are thus two high waters of different heights in the course of 24 hours, together with two low waters whose heights are equal.

Analysis shews that we are to consider the height of the water at any time as due to the combined action of two tides, viz., the semi-diurnal tide, whose variations we have already traced, and a diurnal tide, which vanishes when the moon is in the equator (and thus enables us to investigate the semi-diurnal tide separately). The height of this diurnal tide is at its maximum when the moon is on the meridian; it then increases the high water of the semi-diurnal tide. Six hours after it sinks to zero and then does not affect the semi-diurnal tide; continuing to decrease, its effect is to diminish the height of the semi-diurnal tide; a minimum high water being thus produced twelve hours after the first or maximum high water.

Besides these tides, there is a third variation in the height of the water, known as the Tide of Long Period, going through all its changes in 14 days, and caused by the varying distance of the moon from the equator.

For the sake of geometrical simplicity, we have spoken of the earth as though revolving within a fixed fluid shell and of the varying height of the tide as due to the varying thickness of this shell, as any particular place is successively brought under different portions of it.

But we must now conceive that as the earth rotates the moon is continually raising the waters of the ocean in a spheroidal shape. This spheroid travels round the earth in one day, thus producing a great wave or undulation in the surface, and therefore a perpetual oscillation in the height of the water at any particular place.

Again, the moon, we know, is not stationary in the heavens, but has a motion of its own round the earth from W. to E. in the same direction as the earth's rotation. In consequence of this motion the lunar day, that is to say, the interval between two successive transits of the moon across the meridian, is longer than the mean solar day of 24 hours of the clock. But the lunar day is evidently the interval between two corresponding high waters; therefore, high water is later by several minutes of the clock each day,

The action of the sun is similar to that of the moon, but much less in amount, owing to its greater distance. Were there no moon, the sun would raise a water spheroid and cause three tides, viz., a semi-diurnal, a diurnal, and a long period tide, called the solar semi-annual tide.

Since the oscillation of the ocean surface due to either luminary is very small in comparison with the earth's radius, the whole tidal oscillation is the sum of those due to the sun and moon separately.

The amount of the lunar tide is about 2.1 times that of the solar.

At new and full moon, lunar and solar high waters occur together, and the highest high waters occur; similarly the lowest low waters occur at this time: these are the *spring tides*.

When the moon is in quadrature, that is, when it is half moon, solar low water occurs at the same time as lunar high water, thus at this time high water is less than at any other; whilst since solar high water synchronizes with lunar low water, the highest low waters occur at this time: these are the *neap tides*. Hence the spring tides at open coast stations are 3.1, and the neap tides only 1.1, each reckoned in terms of the solar tide.

At new and full moon, when the sun and moon arises syzygy, actual high water occurs at the time of lunar high water, as we have just seen, that is when the moon is on the meridian. But in other positions of the luminaries, the compound luni-solar high water will not occur when the moon souths, but at some time intermediate between those of the lunar and solar tides: this deviation being in advance or in arrear of the lunar tide according as the crown of the solar tide precedes or follows the crown of the lunar tide: the maximum advance in the time of high water takes place 4½ days after, and the maximum retardation the same number of days before spring tide. This is known as the priming and lagging of the tides.

We have hitherto spoken as if the high water due to the sun or moon occurred at the instant when the luminary crosses the meridian; but, owing to friction and other causes, the axis of the water-spheroid *lags behind* the moon or sun, so that lunar or solar high water does not occur when the corresponding luminary crosses the meridian, but after a certain interval of time, which, on a rough average, may be taken as three hours.

We shall find it convenient to imagine the lunar tide as produced by an imaginary moon, which always crosses the meridian three hours after the real moon; and, similarly, the solar tide as produced by an imaginary sun, which crosses the meridian three hours after the real sun. Thus the axis of the two water spheroids will always be directed towards these imaginary tide-producing bodies, and our previous explanations will be brought into accordance with the fact that high water in reality occurs about three hours after the moon's transit across the meridian.

The action of the luminaries being greater as the distance is less, it follows that the spring tides in the winter, when the sun is at his least distance from the earth, will be rather greater than in the summer, and the neap tides rather less. The action of the moon also will be greater the nearer she is to her perigee; thus the greatest tides that can happen are the spring tides, when the moon is in perigee and the earth in perihelion; this explains, at least, partly, the enormous tides which occasionally do such great damage.

The diurnal tides have been really found to exist: thus, at Plymouth, the morning tides in the winter are higher than the evening, and *vice versâ* in the summer. In some places near Behring's Straits this difference between the morning and evening tides is so great that there appears to be only one high water in the day.

Such in its main outlines is Newton's celebrated theory of the tides, but it would be tedious at present to pursue it into further detail.

Eleven years after his death the French Academy offered a prize for an essay on the tides, and which in 1740 was adjudged to Daniel Bernouilli, Euler, Maclaurin, and the Jesuit Cavalleri, in whose person Descartes' theory of Vortices received its last honours. The others all adopted Newton's theory; Bernouilli treated it analytically, and from his results deduced rules for the practical calculation of the tides.

This theory of Newton and Bernouilli, usually known as the equilibrium theory, from its fundamental assumption, is confessedly inadequate as an explanation of the causes and motions of the tides; indeed, Airy goes so far as to style it "a most contemptible theory" and "grossly imperfect." Nevertheless, it has been of the greatest value; for, whilst rejecting the processes on which they are founded, men of science till recently have agreed in using its results in discussing tidal observations.

With a few exceptions, no continued series of observations were made on the tides till about a century ago; but since the progress of the theory has rendered it able to grapple with masses of observations, and reduce them to law, it has become necessary to obtain accurate and multiplied observations.

For this purpose a self-registering tide gauge has been in use for many years past; its essential features are a vertical narrow cylinder, sunk to a certain depth, so as to exclude the action of surface waves; a float attached to a piston rod working easily within the cylinder, and communicating a properly proportioned vertical movement to a tracing pencil; and lastly, a band of paper, which, by suitable mechanism, is made to travel uniformly past the pencil. A curve is thus traced on the paper, whose abscissæ represent the line, and its ordinates the height of the tide; a graphical record can thus be obtained of the tide wave at any port.

Newton and Bernouilli had, as we have seen, considered the ocean as in equilibrium, at every instant, under the forces animating it. Thoroughly dissatisfied with this assumption, Laplace resolved, in 1772, to investigate the *motions* of the ocean, as caused by the attractions of the earth and heavenly bodies, by the pressure thence resulting among the particles of water themselves, and by the earth's rotation. He assumed that the earth is entirely covered by a shallow ocean, of evanescent density, and also that the depth is equal throughout any particular parallel of latitude.

His ultimate solution shewed him that the oscillation of the ocean is the sum of oscillations of three kinds, corresponding respectively to the tides of long period, the diurnal, and the semi-diurnal tides of the equilibrium theory. The investigations of Laplace constitute what is known as the dynamical theory of the tides, and would be sufficient, had he done nothing else, to place him among the greatest of mathematicians. But the dynamical, notwithstanding its vast superiority over the equilibrium theory, is still but an imperfect representation of the real circumstances of the actual ocean. Accordingly Laplace again attacked the problem from another side.

The law of the rise and fall of the sea may be broadly stated as follows. If we suppose a circle traced on a dock wall, so that the lower extremity of its vertical diameter may coincide with low water mark, and the upper extremity with high water mark, and if we divide its circumference between these points into six equal parts, representing each one hour, then the tide will, as it rises, just cover one of these divisions each hour, and similarly uncover one for each hour that it falls. A rule founded on this is in practical use among seamen for finding the alteration produced by the tide in the soundings marked on the chart. This motion of the water is what is termed a simple harmonic motion.

Let us suppose that, as the minute hand of a clock travels round the face, a point moves along the vertical diameter, so as always to keep on the same level as the extremity of the hand. This point then will have a simple harmonic motion. Let us suppose the hand and the point to start from the figure VI. of the dial : at first, then, the upward motion of the point will be very slow ; as the hand gets nearer to IX. the point will move faster, attaining its greatest speed when the hand is at IX. ; its speed will then decrease as the hand goes towards XII. Thus we see that the velocity of a simple harmonic motion is continually varying : thus—though the water will cover equal arcs of the circle on the dock wall in equal lines, its vertical rise in the same time will vary greatly.

Now just as the absolute motion in space of a man on board a ship is compounded of his motion relative to the ship, of the ship's motion relative to the earth, and of the earth's motion in space, so we may conceive a motion compounded of several simple harmonic motions.

Owing to the varying distances and positions of the sun and moon, the tide-producing forces which they exert are always varying in intensity ; for example, the varying distance of the moon from the earth produces one variation in her tide-producing force, her varying distance from the equator produces another. Now, Laplace was led to conclude, from his mathematical results, that each such periodical variation in the tide-producing forces causes a corresponding variation in the height of the tide, and that the height of the tide at any port is the sum of these separate oscillations. This conclusion—almost the only practical result of the dynamical theory—may be stated thus: the height of the water at any place is the sum of the heights due to several simple harmonic motions, whose periods depend on the motions of the sun and moon.

Each of these simple harmonic motions may be termed a tidal constituent, or, for brevity, a tide. To render clearer this complex dynamical action, Laplace conceived each of these partial tides as produced by a corresponding imaginary star moving uniformly in the plane of the equator.

The periods of these tides being known, their other data are determined from actual observations by the application of a profound analysis.

A Committee of the British Association, under the presidency of Sir William Thompson, is at present engaged in reducing series of tidal observations made in different parts of the world. One of its first reports was made at the meeting held in Brighton.

The larger a sea is, the more perceptible must be the phenomena of the tides. In a fluid mass the impressions which each molecule receives communicate themselves to the whole mass; and thus it is that the action of the sun, which is insensible on an isolated molecule, produces on the ocean such remarkable effects. The Black Sea and the Caspian have no tides, and the greatest range of the tide in the Mediterranean is not more than four feet.

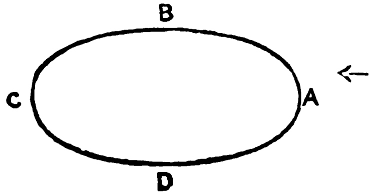
But a sea which is too small for the production of perceptible tides by the sun and moon, may have *derivative* tides; that is to say, undulations which are excited primarily by the disturbing effect of the luni-solar tide-wave, and subsequently propagated by mechanical action among the particles of water. The tides in the English Channel are of this nature.

It appears a universal rule throughout the English Channel, that at any great distance from either shore the tide-current runs up the Channel nearly three hours after high water, and down the Channel nearly three hours after low water; and that on the English side of the Channel, especially opposite the entrances of bays, the direction of the current revolves in 12 hrs. 20 min. through all the points of the compass, in the same direction as the hands of a watch, the observer's face being directed up the Channel ; and that on the French side they turn in the opposite direction. Thus, at some distance from shore, we see that the time of high water does not coincide with that of slack. This is well-known to sailors, who term the tide-current which flows up Channel for three hours after high water tide and half-tide. Nevertheless, they have often noted down the time of slack water as that of high water, and thus caused no small confusion and trouble in the discussion of their observations.

The dynamical theory of Laplace gives no explanation of this phenomenon ; but the present Astronomer Royal has discussed the mathematical laws of the tides considered as waves propagated through the sea ; and his theory, besides giving similar results to Laplace's as to diurnal and semi-diurnal tides, explains the tides in rivers, which the other fails to do.

We have seen that the tides in the Channel are derivative : the rise and fall of the tide at any place is due to an undulation of the surface which is propagated through the water, by means of comparatively small oscillations of its component particles.

Theory shows that, in the case of the tide wave, in seas like the English Channel, each particle of water describes about its position of rest an elongated ellipse in a vertical plane, having its longer axis horizontal and in the direction in which the wave is travelling.



Let us trace the path of a particle in the surface, which we will suppose to start from *A*. It will travel round towards *B*. At *B* its motion will be entirely horizontal and up channel. But *C B* is the greatest height to which the particle attains. Thus, when it is at *B*, *high water* occurs ; the particle continues to move onward, but its height diminishes ; thus, as the tide falls, the current continues to flow up Channel for three hours, till the particle gets to *C*, where for an instant it has no horizontal motion backwards or forwards; it is then *slack water*. The particle then moves backwards towards *D*, and its depth below the level surface, *A C* increases; the tide is then falling, and the tide current flowing down Channel. When the particle gets to *D*, it is at its greatest depth, and *low water* occurs. The particle continues moving on to *A*; the tide begins to rise, but the current still flows down Channel for another three hours, till twelve lunar hours after starting, the particle returns to *A*, and it is again slack water.

The positions of different particles, in their respective orbits, at the same time will depend on their distances from the point where the undulation commences; thus, particles near this point will have travelled further round than those which receive their motion later. If, then, we draw a curve through the positions of the particles at the same instant, we shall have the form of the wave at that instant.

The interval of time by which high water at any place follows the transit of the moon on the day of full or new moons, is termed the Establishment of the Port for that place. This interval is not the same every day, but is subject to a semi-menstrual inequality; it is better, therefore, for scientific purposes to take not the interval on the day of full or new moon, but the mean of all the intervals between new and full moon; this is termed by Whewell the Corrected Establishment of the Port.

Another correction has also to be made, depending on what is called the "age of the tide." The tide at London is determined by the position of the sun and moon 2½ days before it occurs; the time of high water on the day of full moon takes place at two o'clock, but two hours will not be the Establishment, for it must be calculated for the position of the moon 2½ days before, and is thus found to be 1h. 29m.

The correct determination of the Establishment is of the greatest importance both to navigation and science. By adding the corrected Establishment to the time of the moon's transit, we get the time of high water. This is reduced to Greenwich time, and we thus are able to compare the time of high water in all parts of the world.

If, therefore, we draw a curve through all places having high water at the same instant, we shall have the form of the great tidal wave at that instant. Such a line is called a co-tidal line. The first person who attempted to draw these lines was the late Sir John Lubbock; but those given in physical maps are due to the researches of Dr. Whewell.

The co-tidal lines are drawn to represent the position of the tide wave at each successive hour on the day of new or full moon.

Were the ocean such as we supposed when considering the equilibrium theory, the ridge of the tide wave would be a meridional line, travelling westward round the earth in 24 lunar hours, and accompanied by another at 12 hours' distance. There would thus be 24 co-tidal lines, resembling parallels of latitude.

In the real ocean the forms of these co-tidal lines are greatly distorted by the modifying action of the land.

The diurnal tide is found to exist from the Scilly Isles to Portland Bill, but apparently not further east. This shows, in all probability, that the tides in the upper parts of the Channel are compound tides due to the interference of two tides differing by a period of twelve hours, so that the diurnal elevation due to the one is balanced by the depression due to the other. The inbend between Beachy Head and the Isle of Wight appears to have *bay* tides which run up to Portsmouth. The range of the tide, that is, the difference between its heights at low and high water, is 12 or 13 feet from Devonshire to Selsea, 18 or 19ft. at Brighton, 21ft. at Eastbourne, Dungeness, and Dover.

Among the authorities on the subject are Newton's Principia, Laplace's Système du Monde and Mecanique Céleste, Young in the Enc. Brit., Airy in the Enc. Metrop., and Sir W. Thompson's reports to the Brit. Assoc., &c., the papers of Lubbock and Whewell in the Phil. Trans. Other references are Mrs. Somerville's Mechanism of the Heavens and Connexion of the Physical Sciences, Thompson and Tait's Natural Philosophy, vol. I. There is an historical notice by Leslie Ellis prefixed to the De Fluxu et Refluxu Maris of Bacon in Spedding's Edition.

APRIL 27TH.

MICROSCOPICAL MEETING. — MR. W. H. SMITH ON "STARCH."

In introducing the starches as a subject for microscopical examination, he craved the indulgence of those who were well acquainted with such objects, while he assumed, in accordance with the wish of some members of the Society, that the meeting consisted of persons ignorant of the subject. Starch was generally a more or less glistening white powder, consisting of colourless transparent granules of various shapes and sizes, usually distinct and separate, but sometimes united together, forming compound granules. Schleiden also claimed to have discovered it in an amorphous condition, in the bark of Jamaica sarsaparilla, the seeds of *cardamonium minus*, and the stem of *carex arenaria*; but other observers thought that this had not been clearly demonstrated. The occurrence of starch in plants was so universal that its presence was once thought to be sufficient evidence to determine whether a body should be considered to belong to the animal or vegetable kingdom, until it was shown that a body isomeric with starch could be found in certain animals. It appeared to be of the same value to a plant that fat was to an animal, or, in other words, it was a store of nourishment laid up for future use; hence it was found most abundantly in those plants, and parts of plants, which were likely to require a large amount of nourishment in a short time. Thus many plants accumulated starch in their roots to an enormous extent before flowering, in order that they might have support during that important period of their existence. Carrots, turnips, and radishes were familiar examples of this kind of plant, whose roots were most fit for use just before flowering, when every cell was gorged with starch granules, but were woody and useless when the plant had run to seed and the granules, having served to support it during its inflorescence, had disappeared.

Starch was composed of carbon, united with the elements of water, and although all starch had the same chemical composition, yet every variety was more or less contaminated with some of the peculiar secretions of the plant from which it was derived, and hence the superior value of certain starches over others as articles of food. It would unite with an alkali such as potash, forming a soluble salt, and could be precipitated by double decomposition from its solution, as an insoluble amylate of lime, baryta, lead, or silver, and thus pure starch was readily obtained for the purpose of analysis. Being an insoluble body, starch could be taken up by the juices of the plant in that condition, but when required for use was converted into dextrine and sugar, which, being soluble substances, could be immediately employed for the nourishment of the plant. Unlike chlorophyll, which would only develope in structures exposed to the light, starch was always found most abundantly in those parts which were deep-seated and removed from the light.

A fully-formed starch granule usually presented a small rounded spot called the *hilum*, generally situated at one end, around which were grouped a number of concentric lines, which might be made more evident by careful dessication. This appearance had given rise to a large amount of discussion as to what was the real nature of a starch granule. Some observers maintained that the granule was a true cell filled with a substance which was alike throughout, that the hilum was an opening into this cell, and that the appearance of lines was caused by the unfolding of the walls of the cell. In support of this view Bush gave the following experiment. Saturate a few granules with a strong solution of chloride of zinc, having a small quantity of iodine mixed with it. On the addition of a small quantity of water the granules would gradually expand, developing at the same time a frill-like plicated margin, which slowly opened out; the plications on the granule might then be seen slowly unfolding, and might be traced in many cases into the rugee of the frill. The granule at length swelled up to twenty or thirty times its original bulk, appearing as a flaccid sac, though no extrusion of matter could be observed during the experiment. Other observers considered that the granule was a cell, and that the *hilum* was an opening into it, while the concentric lines were caused by successive deposits extending from the nucleus to the outer wall, and varying in density, the outer layer being most compact. In support of this view the following experiment was given. If a little potato starch was heated on a metal plate to 360 degrees or 390 degrees, and then examined after treatment with a little water, the several layers would be found swollen, and by adding an aqueous solution of iodine they would be made to appear with considerable distinctness. Reid saturated starch granules with glycerine, and placed them while in this state in contact with water, when endosmotic changes followed, the less dense liquid being absorbed. After the absorption the grains were found to have burst in the direction of their axes, the rupture indicating a membrane that had been corrugated by release from unusual tension, whilst the covering of the remaining portion of the granule was visible, in distinct longitudinal wrinkles, from the *hilum* downwards. He submitted that were the corpuscle composed of superposed laminæ only, the addition of water in the manner described ought not to rupture it, or if this happened, the fracture would be in the direction of the laminar surfaces and not at right angles to them or their supposed order, as happened in his experiments. He further held that the bands or lines observed in starch grains were mere plications of the outer membrane, because they entirely disappeared on swelling the corpuscles with any liquid.

Others again considered that the nucleus was a point either solid or hollow, from which growth proceeded, and that the lines represented successive deposit on the exterior varying in density, there being no investing membrane at all. We were accustomed to say that while the cold water had no action on starch boiling water would break up its granules and dissolve them, but this seemed to be very doubtful; for if one part of starch were boiled with 100 parts of water, the white colour of the corpuscles would disappear and the whole present a perfect solution, which would traverse a compact filter. Payen immersed the bulb of a hyacinth in such a filtered solution, and succeeded in separating the apparently-dissolved starch; for there appeared, as the rootlets absorbed the water, particles of starch adhering to them, which were turned blue by iodine, whilst a section of the roots of the bulb gave no indication with this test of the presence of amylaceous matters. Hence it was evident that the fine capillaries of the plant, being too small to permit the passage of the particles of starch, caused their accumulation on the surface.

Starch was also separated from its apparent solution by freezing and thawing several times, when it was precipitated in flakes, and could be made into a felt-like substance, which was used in the manufacture of certain kinds of cartridges and for other purposes, as a substitute for paper. It would appear that boiling water did not dissolve starch granules, but increased their size to an enormous extent and rendered them transparent. He had seen it stated that

Jacquelin had been able to heat starch granules to 300 degrees in water, and then regain them in their original form by simple evaporation of the water ; but he should like to see such a granule.

Examined by polarised light the starch granule gave a black cross, which changed as the prism was rotated, or when a selenite plate was interposed a coloured cross, on a different coloured ground, and it then formed one of the prettiest objects that could be exhibited under the microscope. Starch was obtained by rasping or grinding roots, &c., and then washing the mass upon a sieve ; by which the torn cellular tissue was retained, while the starch passed through with the liquid, and eventually settled down from the latter as a soft white insoluble powder. Starch from the grain might be prepared by mixing the meal with water to a paste and washing on a sieve ; but it was commonly manufactured on a large scale by steeping the material in water for a considerable time, when the lactic acids, always developed under such circumstances from the sugar of the seed, disintegrated, and in part dissolved the azolized matter, thereby greatly facilitating the mechanical separation of that which remained. A still more easy and successful process had lately been introduced, in which a very dilute solution of caustic soda, containing about 200 grains of alkali to a gallon of liquid, was employed for the same purpose.

Among the starches which would be exhibited were sago and tapioca, which one saw figured in nearly every work on the microscope, but of which he had great difficulty in obtaining samples. The articles sold under those names consisted of starches in a partially cooked state, some of the granules having been converted into a kind of mucilage, which had firmly cemented the remainder into compact masses. But both sago and tapioca had been imported in the raw state, and, judging from the appearance of some of the soluble cocoas, there must be a considerable quantity of sago meal in England somewhere. Arrowroot, known as West Indian arrowroot, obtained from the tubers of *Maranta Arundinacea*, formed the ordinary arrowroot of commerce, the value of which varied so greatly with the amount of care taken in its preparation and the part of the world from which it came, that the higher qualities were quoted at fully three times the value of the lower, although obtained from the same plant. East Indian arrowroot yielded by the Rhizomes of *Curcuma Angustifolia* and *Clencorrhiza*, had a very characteristic appearance and was generally figured in microscopical works, but it seemed to have disappeared from commerce, for he was unable to obtain a sample from several of the principal wholesale druggists. But this was not the case with English arrowroot, which, being only potato starch, was readily obtained, and sometimes changed its name for that of West Indian arrowroot. Another curiosity was Portland arrowroot, which was made in Portland Island, from the root of *Arum Maculatum*, and yet another was Tahita arrowroot, made by the converts of the missionary, John Williams, from the tubers of *Tacca oceanica*. These, then, together with some more common starches, such as those of peas, beans, wheat, &c., would be exhibited, and he thought he had said all that he need say concerning starch.

Mr. T. W. WONFOR enquired whether much of the disease to which infants were subject arose from their being fed upon different foods, consisting principally or altogether of starch, mixed with water instead of milk?

Mr. SMITH : There was no doubt much illness and even death had resulted from infants being fed on some so-called cornflowers mixed with water alone.

The meeting then became a conversazione, when Mr. Smith, Mr. Wonfor, Mr. Dennant, and Mr. Glaisyer exhibited the various kinds of starches, provided by Mr. Smith, and shown under polarised light. They comprised the largest grain of the starch from *Canna edulis*, the skin of the potato, ginger presenting starch grains *in situ*, and other objects mentioned in the paper read. Salep—the root of different kinds of orchids, used in India instead of arrowroot, and a few years ago, before the establishment of early coffee-houses in London, sold under the name of " Sallop "—which contained a kind of arrowroot, was also exhibited.

11TH MAY.

ORDINARY MEETING.—MR. H. GOSS "ON THE GENERATION OF INSECTS, ESPECIALLY PARTHENOGENESIS, WITH OBSERVATIONS ON HERMAPHRODITISM."

Before proceeding to the main subject of the paper, it would be necessary to make a few preliminary observations on the nature of insects, the place which had been assigned to them by naturalists in their classification of the animal kingdom, and the orders into which they had been divided.

Insects were animals having articulated bodies divided into three chief portions, namely, the head, the thorax, and the abdomen. They had three pairs of legs and generally two pairs of wings, and in their perfect state two eyes and two antennæ, and they passed through several transformations, called their metamorphoses before attaining the perfect or highest state of their existence.

The transformations through which insects passed during the cycle of their existence were four, namely, the egg, the larva, the pupa, and the imago or perfect state. These transformations or periods of existence differed widely from one another in the various orders of insects. In some orders—for instance, in the Lepidoptera—these periods of existence in the life of the insect were very distinct, and during no one of them did the insect bear any external resemblance to that which it possessed in another. Sir John Lubbock observed, when writing on the subject of metamorphoses, that "some insects acquire their full bulk in a form very different from that which they ultimately assume, and pass through a period of inaction in which not only is the whole form of the body altered, not only are legs and wings acquired, but even the internal organs themselves are almost entirely disintegrated and reformed." On the other hand, in some orders—such as the Orthoptera—there was not so marked a distinction between the larval, pupal, and perfect states, the changes consisting of a gradual increase of size and in the acquisition of wings.

In order to explain the position occupied by insects in the animal kingdom, it would be necessary to allude to the systems of classifica commenced by our countryman Ray, by Linnæus, Brisson, and oth and finally perfected by Cuvier.

In the “Systema Naturæ” Linnæus divided the animal king into six groups, namely :—1. Quadrupeds ; 2. Birds ; 3. Amphi 4. Fishes ; 5. Insects ; and 6. Worms.

Subsequently Brisson separated the cetaceous animals (wl and dolphins) from the fishes and placed them next to the quadru

Linnæus subsequently rejected the old division of Quadr and introduced the name of Mammalia, which, as expressing manner in which the young of viviparous animals were nourishe distinguished from oviparous animals, constituted the great distin between the first and subsequent classes of the first division c animal creation.

The first four classes, namely, the Mammalia, the Birds Reptiles, and the Fish, were subsequently formed into one great f of *vertebrate* animals, and all the lower classes were comprise second family of *invertebrates*.

The arrangement by Linnæus of the invertebrates into two c (the insects and worms) was very imperfect. Cuvier was the fir reduced the arrangement of the invertebrates to a satisfactory dition. He divided the animal kingdom into four divisions, nam 1. Vertebrata ; 2. Mollusca ; 3. Articulata ; 4. Radiata.

The only division to which he should call especial attenti the third one, as that included the class, the origin and genera which was the main subject of the paper.

The third division, called Articulata, was divided into four c namely :—1. Annelida ; 2. Crustacea ; 3. Arachnida ; 4. Insect

That portion of the animal kingdom under particular consid was, therefore, according to Cuvier's arrangement, the fourth c the third division.

Cuvier divided the class Insecta into 12 orders, the prin which were :—1. Coleoptera ; 2. Orthoptera ; 3. Hemiptera ; 4 roptera ; 5. Hymenoptera ; 6. Lepidoptera ; 7. Diptera.

Professor Westwood, in his introduction to the modern cla tion of insects, had divided insects into 13 orders, all the principal of which were the same as those before mentioned in Cuvier's arrangement, with the exception of the order Hemiptera.

These orders had also been divided according to the nature of their metamorphoses, into two groups, namely, Heteromorpha, or, as Professor Westwood has described them, "those in which there is no resemblance between the parent and the offspring; and Homomorpha, or those in which the larva resembles the imago except in the absence of wings. In the Homomorpha (which include, amongst other orders, the Orthoptera, the Hemiptera, and certain Neuroptera) the body, legs, and antennæ are nearly similar in their form to those of the perfect insect, but the wings are wanting." The Homomorphic insects did not pass through such distinct changes of form as the Heteromorphic, and were active during all the stages of their existence (except, of course, the egg state), so that, as explained, there were not, in fact, in *all* orders of insects four well defined periods of existence, but in many cases the progress of development towards the final stage of the cycle of the insect's existence was gradual and almost imperceptible.

The generation of an insect was the commencement of the *germ* of its existence. After generation the subsequent life of the insect consisted in development. The first state in which the insect might be said to have an independent existence was the egg. The egg, under the requisite conditions of light, air, and heat, produced the larva which attained development by means of nutriment. The larva fed voraciously, and after undergoing many changes of skin, attained its full size, and then changed into the pupa state, during which it lived upon its own fat. Burmeister says that, "during the pupa state the intestinal canal of the larva shrivels up, and at its expense the organs of generation are developed." When the last transformation had been completed, the perfect insect made its appearance in the highest state of its development. The end of this last stage of its being appeared to be propagation and the commencement of the cycle of a new generation.

Whilst on this part of the subject, he would read an extract from a paper communicated to the Journal of the Philadelphian Academy of Natural Sciences by the late Dr. Brackenridge Clemens. In this paper Dr. Clemens says "Every mature or perfected being has had an anterior organic history included in the history of its structural progression from a collection of simple cells to a natural body possessing undivided and distinctive characteristics. No one of its states or conditions constitutes species; neither the perfect insect, nor the pupa, nor the larvæ, nor the ovum fulfil in themselves the conception involved in this term, but simply represent the various relations the individual maintains to physical and animated nature, and during the continuance of which its structural biography is written. The perfect being is the temporary expression of a thought or conception involved in the series of actions which constitute in their entirety a special and definite creation, and in this state has reached the acme of its perfectibility, a point beyond which it cannot pass; but after a variable period its organic part is broken up and resolved again into the simple or primary elements of matter.

"The species, or the thought, however, does not cease to exist during the process of organic disintegration of the individual, and previously to its disappearance or death it represents its special organism, or rather its species, by means of an ovum in which the organic actions destroyed by the previous representation are recommenced and again carried through a series of changes or states to the point of its previous organic perfection, commencing in the simplest organic state and continually returning to it to renew a series of predetermined special developments. We have in species a cycle of persistent ceaseless actions revolving in their narrow humble orbit with all the indications of design, and with comparatively as much invariability as the great planets observe in their appointed paths. It is a conception, inasmuch as from a structureless body or material is evolved a constant preordained manner, one having a highly complicated arrangement of organs whose actions and functions result in the production of phenomena known as those of life. The ovum in which the organic cycle may be said to have its inception is endowed with no fortuitous or independent impulse of evolution. Up to the period of its maturity it has formed an integral and necessary part of some pre-existing natural body. It is, indeed, a component of the organism quite as much as any other aggregation of specialized cells, and partakes of all its characteristics of growth. To endow it with this impulse not even the procreative act between the male and female organism is absolutely imperative, and its specific evolution may be recommenced independently of this extraneous aid and continued to the production of a new perfect being."

Generation has been divided into two classes,—1. Single or equivocal generation; and 2. Double generation or propagation.

Double generation or propagation was of three descriptions,—1. A portion of the old individual might be separated and become an independent being, which was called propagation by shoots. 2. In the body of the old individual the commencement of a new one might be spontaneously developed, which germen, having attained its maturity, quitted the maternal sphere and maintained a separate existence, which was called propagation by germens. 3. The usual method of propagation by the development of the germ by the reception by the mother by intromission of a peculiar exciting fluid.

The last method of propagation was called sexual. The active individual or portion was called the male, and that upon which it acted, the recipient or germ-forming individual, the female.

Where these two faculties were united in one individual it was then called Hermaphrodite; an abnormal state of organism to which he would allude more particularly afterwards.

On the subject of single or equivocal generation he had but little to say. By means of it only the very lowest order of organism was produced. The best known instances of generation by this means occurred in that of a particular species of louse, which originated upon the skin and collected in great numbers at particular spots.

Certain species of acari were also developed in the same manner.

Professor Burmeister says:—"The second kind of propagation, that by shoots, has not yet been observed in insects; it is also perfectly contradictory to the idea of creatures so highly organised as they are. Some observations, however, seem to confirm the possible development of insects from *germens* or *eggs* laid by an unimpregnated female."

Subsequent investigation and researches had proved that not only was such a mode of development (as the last named) possible, but that it was of not unfrequent occurrence. This mode of propagation by germens constantly and regularly took place in certain genera. In others it occurred only occasionally. As a regular mode it was ascribed to the Aphides, or plant lice. These produced throughout the summer living female young ones, which again, without any preceding impregnation, according to De Geer and Bonnet, produced living f young ones This spontaneous generation was repeated to the generation. After this a generation of males and females again their appearance.

On this subject he could not do better than quote Profess Siebold, whose work on the subject of Parthenogenesis had been lated by Mr. W. S. Dallas. Von Siebold says : "It is well- that in the Aphides, a sexual generation represented by se males and females, is followed by a series of generations o cluding a single form, which proceed from each other in m repetition, without any previous copulation, until after about se eleven such generations a generation of males and females makes its appearance.

"Steenstrup regarded these forms of Aphides, which are c of reproduction without the influence of the male generative and which had been previously looked upon as virgin female A as Nurses, and consequently as those members of an animal subjected to an alteration of.generations which are capable ducing young in the asexual state. Those Aphides which brin living young, without a preliminary copulation, are in realit different in their organization from the female Aphides, which l capable of development after the act of copulation.

"In the viviparous Aphides those organs, specially from the living young are produced, have quite a different fo organization from the sexual organs of the oviparous A so that in opposition to the ovaries, the products of which (egg become capable of development by the action of the male se may with perfect justice indicate the organs as germ stocks are capable of producing young of themselves without the i of male fertilizing organs.

"These nurselike viviparous Aphides therefore, which, in ovaries, bear germ stocks in their interior, are also destitut seminal receptacle which occurs universally in the female of and plays an important part in the fecundation of eggs."

The terms "germ stocks" and "germ body" had been distinguish the reproductive organs of the viviparous asexual from the eggs and ovaries of the oviparous female Aphides.

Thus much on the subject of spontaneous generation bodies by asexual individuals. He would next allude to the other mode of spontaneous generation by true virgin females. This mode of reproduction had been called by the older naturalists "Lucina sine concubita," and is now generally known as Parthenogenesis.

Burmeister says "that unimpregnated females lay eggs may be observed in the Bombycidœ if, some days after their escape from the pupa case, they be impaled and allowed to die slowly. The females of the Sphingidœ do the same ; but never the butterflies, according to Roesel's observations."

This, of course, was known to be the case from the personal observation of all who had bred any of these insects. It must not be supposed that these unfertilized ova as a rule produced larvæ. It was indeed only very rarely that young were disclosed. As a rule these eggs were sterile, but the exception to this rule was known as Parthenogenesis or the generation from ova laid by unimpregnated or virgin females.

This mode of generation, although comparatively rare, appeared, according to the observations of such unquestionable authorities as De Geer, Rèamur, Bonnet, Schiffer, Müller, Pallas, Ochsenheimer, Roesel, and others, to be of not unfrequent occurrence.

In the Lepidopterous Genus Psyche, not only the Entomologists before named had observed it, but many now living could furnish testimony in support of their statements. He would cite instances in which this mode of generation had been observed.

The oldest communication on the subject was due to J. T. Albrecht, of Hildesheim, who wrote to the Leopoldine Academy of Naturalists in 1701 a memoir, relating that he took a brown pupa, which had spun itself up in a black currant bush, and preserved it under a glass in his summer house to see what moth would be evolved from it. At the end of July a moth of a yellowish white colour escaped from it (the moth was not more particularly described). The moth in a few days laid a great number of eggs and then died. In April of the following year, Albrecht again looked after the glass, and was astonished at finding young black caterpillars in it instead of the eggs.

Another instance on record of Parthenogenesis, was one in *G.*

Querci-folia, related by Bernouilli as having been observed by Professor Basler. Bernouilli himself observed an instance in Cœruleocephala.

Treviranus observed an instance of the same spontaneous development in *S. Ligustri,* Suckow in *G. Pini,* and Dr. Nordman in *S. Populi.*

Shirach stated that a queen bee would sometimes lay fertile eggs without copulation with the drone, and that the females produced by such eggs would again lay productive eggs without having copulated.

Professor Von Siebold had confirmed this statement of Parthenogenesis in the honey-bee; and, although originally very sceptical of the occurrence of this phenomenon in the cases before mentioned, subsequent observations convinced him that Parthenogenesis constantly occurred in some of the Tineidæ, viz., in the Genus Talæporia or, more properly, Solenobia. The two species of Solenobia in which he observed Parthenogenesis constantly to occur were *S. Lichenella* and *S. Triquetrella.* The two species of sac bearers just mentioned were not, however, the only representatives of true Parthenogenesis; an equally striking example of the virgin reproduction of a female insect was presented by *Psyche Helix.*

Von Siebold had further established the constant occurrence of Parthenogenesis in the case of *Bombyx Mori* (the silkworm moth).

One more instance he would cite before closing this part of his subject. He alluded to the Genus Cynips (or the Gall Flies). Of this genus some twenty eight species were known, which according to Hartig were all destitute of males. Hartig was said to have inspected 9,000 or 10,000 of *Cynips divisa* and 3,000 or 4,000 of *Cynips folii* and found no single male amongst them. He even collected *C. folii* for eight years and never obtained anything but females, and he observed these female Cynipidæ proceed to the deposition of their eggs immediately after their issuing from the galls.. A male cynips had, however, been subsequently discovered. Mr. Frederick Smith, of the British Museum, the well-known Hymenopterist, writing in the May number of the Entomologists' Monthly Magazine for 1869, says, "through the kindness of Mr. Darwin I have received both sexes of a species of Cynips; they were bred from the black oak by Mr. Benjamin Walsh, the American Hymenopterist. The gall from which the male and female were obtained is larger than the bullet gall of the oak, so common in England, being two inches or more in diameter. According to Mr. Walsh's observations the males are only obtained from those galls which develop flies early in the season, two months before the great autumnal brood appears, the latter all being invariably of the female sex. Following up this we may hope this year to obtain males of *Cynips Lignicola.*"

It will be seen from the instances cited that Parthenogenesis certainly occurred more generally in the insect world than the few at present discovered examples led us to suppose. Von Siebold was of opinion that it occurs in accordance with determinate laws which had hitherto entirely eluded our observation.

In Nature definite objects were probably obtained by it which we could only comprehend when we should have learnt to know the life and actions of insects in general more exactly than was at present the case.

Before commencing the subject of sexual generation, a few observations were necessary on Hermaphroditism among insects. It was no doubt well known that perfect Hermaphrodites amongst animals were found only in the tape worm, many Annelida (for example, the leech and the earth worm), and the majority of the Mollusca. In insects, according to present observations, Hermaphroditism was but one-sided, the left side generally exhibiting female forms and organs and the opposite side male organs.

According to Professor Burmeister, the earliest observations on this subject were made known by Schäffer; then Scopoli described an instance. Communications of this kind then became more numerous. Esyer described a specimen of *T. Cratægi,* in which the right side was male and the left side female. Then Hetthuger a similar one of *B. Quercus.* Capieux saw an Hermaphrodite of *S. Carpini,* the left wing of which was male, but the right with the rest of the body female.

Ochsenheimer made a complete list of the Hermaphrodites which, up to his time, had been described, or which he had himself seen or possessed.

He divided all Hermaphrodites into two groups, viz., into perfect, in which one side was perfectly female and the other perfectly male, and into imperfect Hermaphrodites, where the habit of one sex prevailed throughout the entire insect, and the forms of the other were perceptible in solitary parts. From this list of observed Hermaphrodites, made by Ochsenheimer, it appeared that in fourteen out of the twenty-three instances there cited of true Hermaphrodites, the right side was male and the left female.

Curiously enough, in the only specimen of a true Hermaphrodite which he ever saw alive, and which was now in his cabinet, the right side was female and the left side male, in exception to the general rule. This Hermaphrodite was a specimen of *Gonepteryx Rhamni*, and the greenish white colour of the female (right) wings contrasted very strongly with the bright sulphur yellow colour of the male (left) wings.

Among the imperfect Hermaphrodites the majority, viz., six out of eleven in Ochsenheimer's list, were females, and the minority male with female characters.

Scopoli seemed to have been of opinion that Hermaphrodites sufficed to themselves, but subsequent writers on the subject appeared to think this not to be the case.

It appeared that many of these so-called Hermaphrodites were really nothing more than monstrosities, because on anatomical inspection they were found not to possess perfect female organs in conjunction with perfect male organs, which must exist to constitute true natural Hermaphroditism.

In conclusion he would allude to the third and regular method of generation, which was called sexual. The methods of generation previously alluded to being of course quite exceptional and abnormal. As a rule all insects were of separate sexes and required the admixture of both sexes in order to be fruitful.

The union of the sexes by copulation was followed by the formation of the egg and the development of the embryo.

The differences of the sexes in size, form, and colour, were very striking in most species.

First as to size and form. It might be stated as a rule that the body of the female was always thicker, larger, and generally more convex. On the other hand the male was generally slenderer, smaller, more delicately formed, and provided with longer legs. These characteristics were particularly noticeable amongst the Coleoptera.

Another point worthy of notice was that the females of certain species were invariably apterous, the males never so. In the Lepidoptera the females of the two species of the genus Orgyia amongst the Bombycidæ were invariably apterous. So were the Psychidæ. Amongst the Geometræ were the following genera the females of which were entirely apterous, Phigalia and Myssia, and the following in which the females were either entirely apterous or possessed wings only partially developed, Hybernia (including five species), Anisopteryx and Cheimatobia (two species).

Another peculiarity of sex was that the males of many of the Bombyces and Geometræ had doubly pectinated antennæ, whereas those of the females were much less strongly pectinated, or were merely simple and setiform.

In the Genus Blatta, of the order Orthoptera, the females were partially apterous.

The differences of colour in the sexes were also very remarkable. As a rule (to which, however, there were some striking exceptions) the colours of the male were brighter, more beautiful, and more glittering than those of the female. In the Genus Lycæna, or Polyommatus of the Lepidoptera, the males were (with two exceptions out of 10 species) of beautiful shades of blue, whereas the females, with two exceptions (in Argiolus and Arion), were of a dull brown. In Iris, as was well known, the wings of the male were shot with splendid purple, but the female was of a dull brown.

One of the most notable exceptions to this rule occurred in *Thecla Quercus,* the males of which were dull purple throughout, whereas the fore wings of the female were enlivened by a patch of brilliant blue.

The butterflies copulated about noon in the brightest sunshine.

The crepuscular and nocturnal insects copulated at those times. After copulation the male frequently died from exhaustion.

The impregnation of the female produced the development of the germs of the eggs lying on the tubes of her *ovaries*.* After the development of the egg was completed, the period for depositing it arrived, which took place immediately, to make room for an immature egg. When the egg had been laid a distinct life, tl the embryo, commenced in it. Externally the egg appeared to c of a horny shell, which got hard after exposure to the air. Be the external membrane lay a second and more delicate one, formed the case of the fluid contained in the egg. The fluid w. yolk, which was stated chemically to consist of albumen, animal yellow fat, and sulphate and phosphate of natron. Accord Suckon's observations, a small dark spot was formed in the cer the' originally tolerably clear yolk, which was the sign c commencement of the embryo. After a short time th bryo appeared as a half moon shaped body, at the e which the head was already perceived. The embryo sw a bright green but clear fluid, and was enclosed by two membranes besides the shell. Michelotti's experiments (quot Burmeister) upon the eggs of *L. Dispar* and *L. Mari* had prove the eggs during their development decomposed air, viz., in oxygen and gave out carbonic acid, but only in a temperature o 15° to 20° (Reaumur). As the embryo increased in size, its e formation could be seen through the egg shell. Burmeister that the sexual organs might be observed during the last few c the embryo period and presented themselves in both sexes as knobs.

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* See a letter from M. Victor Andouin to M. Arago, in the "Annales des Sciences Naturelles," July, 1824.

The commencement of the nervous system consisted c extremely delicate, scarcely perceptible filaments, into whi nervous matter by degrees accumulated. The muscular layers b the skin were also indicated, and particularly the head, w mandibles, the legs, and the anal horn.

The matured embryo, in its convoluted position, might diately before its development into the larval state be seen t the thin egg shell. After these evolutions the young larva b way through the egg shell, immediately commencing its first an important occupation, eating. The first meal was very frequen egg shell from which the larva had just emerged.

The President (Mr. J. DENNANT), on behalf of the mem the Society, thanked Mr. Goss for his paper, and hoped it wo be the last they would hear from him.

Mr. T. W. WONFOR mentioned that, in 1869, some bullet galls which had been reared in the British Museum placed on some trees in different places, and in every case only females were produced. These were transferred to other places, and, time after time, there were nothing but females. This had been going on since 1869, and no males had been discovered.

Mr. J. E. **Haselwood** said it had been noticed that the aphides during the summer produced only females for ten generations, but when the weather was colder and there was less nutrition, both sexes were produced. To test this, some had been kept in warm atmosphere and supplied with plenty of nutrition, the result being that during four winters only females were produced, thus proving that the cause of sexlessness was the abundance of nutrition and temperature.

Mr. **Goss** said such an instance was quoted by Von Siebold.

Mr. **Haselwood** did not see why all the necessary conditions should not be completed in one as well as two. It was said that the ovaries began to develop before impregnation, and when they reached a certain stage, if not impregnated, they decayed.

Mr. **Wonfor** said there was another point with regard to the aphides. There was a miscroscope slide commonly marked "leaf insect," in consequence of it being covered with leaf-like appendages. That was merely one form of the maple leaf insect, and which also would be found on the sycamore. These peculiar females produced two species, one capable of producing their kind exactly alike, and the other incapable of producing its kind.

It was remarked that Darwin had pointed out that uni-sexual germination was the rule when the organism was not so developed; but when it became more complex bi-sexual re-production became the rule, the latter having a greater tendency to sustain the form and to give a longer duration of life than the other.

"A NEW SPINNING JENNY."

Mr. F. C. **Dennet** brought before the notice of the meeting a new machine for spinning cotton that had been invented in America, prefacing it with a statement of the futility of the attempts made in this country to check the "adulteration" of cotton. He claimed for the "new machine" that it would not only effectually stop any tampering with cotton, but would save half the usual waste, make stronger and better threads, do away with a great deal of the present costly machinery, and dispense with a great deal of labour. The machine was worked on the ground where the cotton was grown, the seed cotton being spun directly it was culled, so that it could not be adulterated in any way. He produced some specimens of the cotton for examination.

The **CHAIRMAN** observed that no doubt it was a clever invention, but it was likely to damage the English and Scotch cotton trade.

Mr. **F. C. DENNET** did not believe it would have that effect, but would be more likely to improve it, since it would send into the market a really *bonâ fide* article; a thread far better in every way than that which could be made from bale cotton.

MAY 25TH, 1876.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON "THE SO-CALLED FUNGUS FOOT OF INDIA."

That fungi were able to induce disease was an accepted theory. Their spores, being very minute, are able to penetrate the pores and openings on the cuticle of animals and plants, and, having once found a nidus, to thrive at the expense of the host into which they had insinuated themselves. Nature, though, had fixed a barrier between the sporule and the organism on which it might settle, and that barrier was healthy vitality. The vitality might be impaired by disease or old age, but when this did not exist, it had not, at present, been shown that the organisms would necessarily succumb to the attack of the fungus. It had been specially noticed that the less vitalized portions of plants and animals were subject to and became the prey of fungus growth. This might especially be seen in the leaves of plants in the autumn, and on the epidermal tissues, such as the wing covers, and the articular plates of flies and insects, and the branchial plates of fishes ; but though such was the case it remained to be proved that the animals attacked were in a healthy condition at the time, or whether the fungus did not the rather follow than produce the disease. In other words, it was a moot point whether the bodies of insects were ever attacked by fungus growth while the animals were in perfect health. This was a very important matter in considering the nature of the influence exerted by *fungi* in the production and maintenance of disease.

That the entire bodies of flies, beetles, wasps, bees, moths, and other insects, when affected by fungus, were found, when examined after death, permeated in every direction by *mycelium*, would be a very significant fact, if we could determine beyond a doubt whether the tissues were not diseased before the advent of the fungus.

Since, then, it was by a large number an accepted opinion that fungi induced and did not follow disease, it was not to be wondered at that a very peculiar form of disease, met with in India, and believed at the time to attack *only the feet* of some of the natives who went about with bare feet, should, from a variety of causes, be attributed to a fungus, the more especially as certain bodies found in amputated limbs, or in the matter discharged from limbs attacked, resembled and were thought to be the resting spores of a fungus. Moreover, microscopic examination and the planting these black particles so as to enable them to, as was believed, grow, led men of the highest eminence as mycologists to come to the conclusion that the cause of the disease was a fungus, which they believed they had been able to rear from particles obtained from undoubted cases of the so-called "Fungus Foot," or "Madura Foot," of India.

The first person to describe this disease as of vegetable origin was Dr. H. Vandyke Carter, in 1860; the Rev. M. J. Berkeley described and figured the *fungus* in No. X. of the "Intellectual Observer," vol. ii., November, 1862; while Mr. H. J. Carter, F.R.S., described it in 1862 in the "Linnæan Society's Journal" and the "Annals of Natural History," and in 1874 Dr. Carter published a monograph on "Mycetoma," or Fungus Disease of India. All these and other publications went to prove that a fungus was the cause of the disease. Dr. Carter had ample opportunities of examining specimens of amputated feet, and matter discharged from affected feet in

India, and separated the disease into two forms—one the *black* and the other the *pale* variety; in addition, there appeared to be an intermediate stage, characterised by the presence of pink granules.

The part affected was more or less distorted, and had numerous openings communicating with channels of various sizes. The materials which escaped from these openings contained brownish-black granules like grains of gunpowder, in one variety, and roe-shaped ones in the pale variety. The alteration of the tissues and bones caused a greasy or waxy degeneration to the parts affected. Dr. Carter considered these black particles the resting spores of a fungus, and the pale an advanced stage of the disease due to a change—seemingly a degeneration—of the darkened masses.

A series of experiments and observations with the black particles, when mixed with cotton soil, placed on rice paste or moist ground rice, both in India and in England, by Dr. Carter and Mr. Berkeley, led to the conclusion that the cause of the disease was a fungus, to which the name *Chionyphe Carteri* was given. The theory of the introduction was that spores becoming attached to the bare feet of the natives germinated and sent in through the pores of the skin their mycelial threads, hence the disease; but the pink mould or fungus, of which the black particles were thought to be the resting spores, had been observed to grow without any connection with the black particles, these black particles being the only substance associated with the malady in which the existence of fungoid elements had been definitely established. These particles too were on every occasion found to be unchanged. Moreover, the pink mould grew just as luxuriantly in connection with preparations which had been preserved in spirit as in connection with specimens of the morbid tissues which had not been subjected to the influence of any preservative fluid.

It was at this stage of the enquiry that Drs. T. B. Lewis and D. D. Cunningham, who had been appointed special assistants to the Sanitary Commissioner with the Government of India to conduct an enquiry into cholera, were deputed to investigate special diseases, as well as continuing their cholera enquiry, turned their attention to that form of disease known as "Madura Foot" or "Fungus Foot" of India.

The materials they had for examination were entire preparations of the *upper* and *lower* limbs—for both hands and feet, it turns out, are attacked by this peculiar disease—as well as numerous smaller preparations. They not only closely examined the condition of the tissues and the nature of the morbid materials present in the various forms of the disease, but morbid tissues and products in other diseases affecting similar parts of the body; they also made various attempts at cultivating the morbid products as well as the study of the resultant organisms and the effects of re-agents on them and other vegetable growths.

In the pale variety they found the bones were reduced to mere masses of soft fat, the muscular and tendinous structures were well preserved, but the most careful microscropic examination of all the tissues and materials failed to afford the faintest evidence of the presence of any fungal or fungoid bodies, or of anything save degeneration of the normal tissues. In a very early stage of this disease, mere alterations in the normal fat were found, and in more advanced cases these degenerative changes could be noticed, showing very conclusively that it was essentially a degeneration of the fatty tissues.

In the dark variety the same degeneration of the bones, the same preservation of the muscles and tendons, less fatty matter, and the presence of the dark grains like gunpowder mentioned before. Here, too, no trace of fungal or fungoid substances was found in any part of the tissues. Not only were both the pale and dark products subjected to every possible test with re-agents and failed, save in some vague points of form, to present anything which could suggest their vegetable or parasitic origin; but in various cultivation experiments no fungus growth was produced in any material in which the supposed spores were planted that was not also produced in some of the same materials in which nothing was planted. Never in any experiment did the black matter evidence any tendency to germinate or become altered in any way.

Similar experiments with the pale failed to give positive results; in fact, the fungus *Chionyphe Carteri* is unhesitatingly pronounced not to cause the disease, and, moreover, that it cannot be developed from the elements contained in the morbid products.

In short, the "Fungus Foot" is a misnomer, and does not owe its origin to a fungus. This is very important, because up to these observations, the opinion that the "Madura Foot" was produced by fungus has formed the basis for generalizations as to the supposed cause of other diseases.

The full reports, with the experiments and subjects operated upon, will be found in the form of an admirable article in the 11th annual report of the Sanitary Commissioner with the Government of India, from the pens of Drs. Lewis and Cunningham, of which he had made considerable use in the brief exposition of the so-called "Fungus Foot" of India.

Various engraved plates were used to illustrate the subject; and Mr. Wonfor made considerable quotation from the official report to which he called attention in his paper. Mr. C. P. M. SMITH, Mr. H. E. HASELWOOD, the President (Mr. J. DENNANT), and others, took part in a short discussion which followed the reading. The point specially discussed was which of these theories was correct—that germs in the atmosphere attacked highly vitalised organisms, or only organisms in a low state of vitality or debilitated by disease. At the close, specimens of fungi, supposed to be the cause of disease in plants and animals, were exhibited under the microscope.

Mr. WONFOR also submitted for examination the hard, earthy cocoon of a beetle. It had been dug up by Mr. Brown, of Trafalgar-street, in his garden on the Round Hill Estate, and it had been brought under the notice of the Society through Mr. Haselwood. The cocoon contained a larva; and, as at one end it was partly broken, the insect could be seen at work. It was placed on a table with the opening to the light, when the grub was seen to be moving its head about, and apparently endeavouring to close the opening by taking from the outside small particles of earth. This went on for a day and on the following morning the aperture was found completely closed with a small piece of flint, obtained from the exterior of the cocoon. The question whether or not the extra expenditure of energy and fatty matter in repairing the cocoon would prevent the full development of the insect,—as was often the case where caterpillars had been compelled from accident to make a second cocoon,—awaited solution in regard to this particular case. The President said the point was so interesting that he would suggest its reconsideration at another meeting of the Society.

JUNE 18TH.

ORDINARY MEETING.—MR. F. E. SAWYER, F.M.S., ON "THE EROSION OF THE SUSSEX COAST, WITH SPECIAL REFERENCE TO GREAT STORMS WHICH HAVE VISITED THE COUNTY."

The present shape of the coast line of Sussex was mainly owing to the two ranges of hills which traversed the County, and in a lesser degree to geological causes and to the rivers. One of these—the South Downs, which in the western part of the County were about 10 miles distant from the sea, terminated in the bold headland of Beachy Head; the other—the North Downs, which, passing through Petworth, terminated in Fairlight Cliffs. The district situated to the south of the South Downs chiefly embraced the Tertiary formations, and it was this district which had suffered most from the sea. A long but shallow bay extended from Selsea Bill to Beachy Head. The latter being composed of chalk had suffered less denudation than the alluvial plains to its west, and thus the bay had been gradually formed. Another, though smaller bay, extended from Beachy Head to Fairlight Cliffs, and this owed its origin to similar causes.

At one time considerable estuaries of the English Channel are said to have extended to Lewes and to Bramber, and it was somewhat difficult to conjecture why these have ceased to exist. In the time of the Romans the Weald was covered with large forests and lagoons, and probably, therefore, a considerable quantity of water made its exit through the valleys of the Adur and the Ouse. When, however, the forests were cut down the rainfall decreased, and consequently less water flowed down the valleys, and a gradual silting up took place. He should surmise that this had taken place at the latest by the year 1400, if not much earlier. Hayley, in his "History of Chichester," states that in the time of the Romans the Lavant flowed entirely round the City of Chichester, whereas it now flowed round two sides only, and that it was probable that the bed of the river was, at an early period, diverted by an earthquake shock. He (Mr. Sawyer) was further inclined to think that since the time of the Romans the whole of the coast of Sussex west of Beachy Head had been slightly raised by an earthquake shock.

There were no very early records of storms on this coast. Tegg's

Chronology mentions a "storm on the coast of Kent, Sussex, and Hampshire, in 566;" and a "Terrible hurricane, at Chichester" was recorded in 995; but no particulars were known respecting them. The earliest storm of which any definite account existed occurred on October 1st, 1250, and was thus described in a manuscript formerly in the possession of Mr. Thomas Martin, of Winchelsea:—

"The moon being in her prime, the sea passed its accustomed bounds, flowing twice without ebb, and made so horrible a noise that it was heard a great distance inland, not without the astonishment of the oldest man that heard it. Besides this, at dark night, the sea seemed to be alight and to burn, and the waves to beat with one another insomuch that it was past the mariners' skill to save their ships; and to omit others, at a place called Huckebourn (Eastbourne) three noble and famous ships were swallowed up by the violent rising of the waves and were drowned." *

Holinshed's account was somewhat similar:—

"On the first day of October (1250) the moon, upon the change, appearing exceedingly red and swelled, began to show tokens of the great tempest of wind that followed, which was so huge and mightie, both by land and sea, that the like had not been lightlie known, and seldom, or rather never, heard of by men then aliue. The sea, forced contrarie to his natural course, flowed twice without ebbing, yielding such a rooring that the same was heard (not without great wonder) a farre distance from the shore. Moreover, the same sea appeared in the night to burn, as it had been on fire, and the waves to strive and fight togither after a maruellous sort, so that the mariners could not deuise how to save their ships where they laie at anchor, by no cunning or shift which they could deuise. At Hertbourne, three tall ships perished without recouerie, besides other smaller vessels. At Winchelsey, besides other hurte that was doone, in bridges, mills, breakes, and banks, there were 300 houses and churches drowned with the high rising of the water course."

This storm diverted the course of the river Rother, which now entered the sea near Rye, but before the storm had its exit to the east

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* Horsfield's History of Sussex.

of Dungeness, 12 miles eastward of the present mouth. Camden, after treating of Hastings, says;—

"Hence the shore retires backwards and is followed inwards, being full of windings and creeks, within which stands Winchelsea, built in the time of King Edward I., when a more ancient town of the same name was quite swallowed up by the raging of the tempestuous ocean, in the year 1250, at which time the face of the earth, both here and in the adjoining coast, was much altered."

Shortly after this storm, and before the town of Winchelsea had recovered from the injuries it had received, another storm occurred which was described in a Latin memorandum found by Jeakes amongst the Rye records, and thus translated:—

"Be it remembered, that in the year of our Lord, 1287, in the even of St. Agath, the Virgin, was the town of Winchelsea drowned and all the lands between Climesden and the Vocher of Hithe. The same year was such plenty of corn throughout all the countries of England, Scotland, and Wales, that a quarter of wheat was sold for two shillings."

In the year 1292 Pope Nicholas the Fourth granted the tenths of all the ecclesiastical benefices in England to Edward I. for six years for defraying the cost of an expedition to the Holy Land, and a complete valuation was accordingly made. About the year 1340 the ninths of wool, &c., were granted to Edward III. A careful enquiry was made in each parish, and the returns afforded a complete record of what changes had occurred since Pope Nicholas's Taxation. These enquiries were called "*Nonarum Inquisitiones.*" From this source we learnt that between the years 1292 and 1340 no less than 5,500 acres in this County were submerged by the sea! The Nonæ return for 1340 for Brighton (made 1341) says:—

"It' dicunt qd ix ps pdca no respondet nc attinge potest ad taxam ecclie pdce p eo qd xl acr' tre submis sunt p mare imppetuu que valuer p annu xl.s,"

which might be thus translated:—

"The same (the jurors) say that the 9th part aforesaid cannot answer nor attain to the taxation of the church aforesaid, for that 40 acres of land are submerged by the sea for ever, which were worth per annum 40s."

The return for Hove stated that 150 acres of land were submerged in that parish worth 10 marks a year, and at Aldrington and Middleton 40 acres were inundated. Early in the 14th century (Dallaway) in his "History of Chichester," says not many years before 1345 Pagham Harbour was formed by a sudden irruption of the sea by which 2,700 acres of land were devastated. In the year 1432 the inhabitants of Shoreham petitioned the King for a reduction of their taxes, "forasmuch as by the encroachment of the sea, &c., the number of inhabitants was reduced from 500 to 36." "A sudden incursion of the sea at Rye, in which the water rose 8 or 9 feet in men's houses at midnight" was recorded in 1570. Elliott's manuscript says:—

"In Elizabeth's reign the sea in a storm broke through the beach bank at Bishopstone and formed what is now called the Old Harbour which was in use till the Newhaven one was made a safer exit. This may have been the same storm as deepened so materially Rye Harbour."

This was the second instance of the course of a Sussex river being diverted by a storm. Formerly, it might, however, be mentioned, the mouth of the river Adur shifted from year to year, going gradually farther eastward towards Brighton, and then back again towards Shoreham. The following interesting account of a storm on November 1st, 1597, was from the Hastings Corporation Records. The pier there was destroyed by the sea, and in 1595 the work of re-building it was begun, but all the works were washed away and a second attempt made, which, it would be seen, also failed.

"This woorke was with singular industrie and arte brought above the full, and by all Hollantyde, 1597, were nere finished, viz., XXX foote high, and C foote at least long, bewtyful to behold, huge, invincible, and unremovable in the judgment of all the beholders, amounting to a great charge, whereunto the whole shire and div's beholders were contributoryes of benevolence, besides the townes great expences. But behold when men were most secure, and thought the woorke to be perpetual, on All Saints' daie, 1597, appeared the mighty force of God, who with the finger of His hand, at one great and exceeding high spring tyde, with a south-est wynd, overthrow this huge woorke in less than a hower to the great terror and adasmt of all beholders, to the great discredit of the lyke woorke hereafter with the country, and to he manifest undoing of the town."

In the following century Brighton suffered severely from the encroachments of the sea. Godwin's rental of the Manor, made in 1665, stated that previous to that year no less than 22 tenements under the cliffs were destroyed by the sea, and between 1645 and 1655 frequent grants of land were made to tenants who had suffered from the inundation, and in one case a tenant lost eight acres. In 1665 there remained, however, 113 tenements under the cliff. The next storm which visited the county was that known as "the Great Storm," which occurred on November 27th, 1703. It was one of the most disastrous storms ever recorded, and indeed some writers had stated that it was the most dreadful storm since the Deluge! Defoe who published a book on the storm, says:—

"At *Shoram* the Market House, an Antient and very strong building, was blown flat to the Ground, and the town shattered. *Brighthelmston*, being an old built and poor tho' populous Town, was most miserable torn to pieces and made the very Picture of Desolation, that it lookt as if an Enemy had sackt it."

"The Bishop of Bath and Wells and his lady were killed at Wells, Somersetshire, by a wall, which was blown down, and 'the Bishop of London's sister, Lady Penelope Nicholas, was killed in like manner at Horsley in Sussex, and Sir John Nicholas, her husband, grieviously hurt.'"—*Milner's Gallery of Nature.*

The same book contains the following curious and quaint description of the effects of the storm in a letter to Defoe:—

"From Medhurst in Sussex, the following Letter is a short account of the loss of the Lord Montacute there which is extraordinary great, tho' abridged in the letter :- Sir, I received a letter from you, wherein you desire me to give you an account of what damage was done in and about our Town. I praise God we came off indifferent well; the greatest damage we received, was the untiling of houses, and 3 chimneys blown down, but 4 or 5 stacks of chimneys are blown down at my Lord Montacute's House, within a quarter of a mile of us, one of them fell on part of the Great Hall, which did considerable damage; and the Church Steeple of Osborne, half a mile from us, was blown down at the same time; and my Lord had above 500 trees torn up by the Roots; and near us several Barns blown down, one of Sir John Mills, a very large Tiled Barn.

"Your humble servant,

"Medhurst, Jan. 18, 1703-4. "JOHN PRINKE."

The following was the record of the storm in the Brighton Town-book :—

" Memorand.—November 27th, 1703, there was a very great and remarkable tempest, which begun after midnight, and continued in its violence till about eight in the morning, being Saturday. Many houses in town were damnified, two windmills in the east blown over, several of the church leads turned up, and several vessells belonging to the town were shipwracked, to the great impoverishment of the place."

The rain which accompanied the storm appeared to have been very salt, as would be seen by the following description from the Philosophical Transactions :—

" Part of a letter from John Fuller, of Sussex, Esq., concerning a strange effect of the late great storm in that County.

' December 6, 1703.

' We live Ten Miles off the Sea in a direct line, and yet can scarce perswade the Country People that the Sea water was blown thus far, or that during the Tempest the Rain was salt, for all the Twiggs of the Trees the day after were white, and very salt, as I am informed almost by every body, tho' I did not taste them enough myself, nor observe it, and that not only upon this Hill where we live facing the Sea, but in all other places within 14 or 15 miles of the Sea, as well as in the Valleys between which and the Sea are several very high Hills, as on the Hills themselves.' "

No doubt Mr. Fuller was unable to make the people believe that the rain was not salt when they could taste it, and indeed salt rain was not so very unusual, for it had been observed on several occasions. Another account of this salt rain was also given in the Philosophical Transactions, by a clergyman at Lewes :—

"A Physician, travelling soon after the Storm to Ticehyrst, about 20 miles from Lewes, and as far from the Sea, as he rode he pluckt some tops of Hedges, and chawing, found them Salt. Some Ladies of Lewes hearing this tasted some Grapes that were still on the Vines, and they also had the same relish. The Grass on the Downs in his Parish was so Salt that the Sheep in the morning would not feed until hunger compelled them, and afterwards drank like Fishes, as the Shepherds report. This he attributes to Saline Particles driven from the Sea."

The destruction of the undercliff town of Brighton, which was commenced by this storm, was completed by another storm on August 12th, 1705, as the following extract from Lee's "History of Lewes and Brighthelmstone" shews :—

"Another dreadful storm reached this town about one o'clock in the morning, but raged not with its greatest fury till after three, and then continued with unremitting violence till the hour of eight. It destroyed a great many houses in the town, and blew off most of the church leads. Every habitation under the Cliff was utterly demolished, and its very site concealed from the owner's knowledge beneath a mound of beach."

He might then remark that there was a very prevalent idea that the town of Brighton formerly stood about as far from the shore as the Chain Pier Head was. From a careful study of the plans, Court rolls, &c., he was convinced that this was an erroneous idea, and he thought that within the historic period the coast line was not more than 200 feet from the present line. Another exploded notion was that the Block House stood in the centre of the town. Horsfield stated that in 1734 "the Gun Garden adjoined the Block House." The Burrell MSS. recorded in January, 1749—"By reason of extraordinary high tides the sea broke in at Brighthelmstone, washed away part of the Block House and the farm lands called Salts, and did considerable damage to the land adjacent." On January 30th, 1775, a portion of the Battery at the end of East Street was washed away, and on November 30th, 1786, its destruction was completed.

The storm of 1705 having destroyed 130 houses, the town of Brighton was almost ruined, and a few years after the inhabitants began to take steps for preventing further encroachments of the sea. This was the first time in the history of the County that we found any record of an attempt to keep back the sea. "Magna Brittannia" (published in 1738), says that at a moderate computation the damage sustained by the town was £40,000. It was found that the tendency of the tide was to roll the beach from west to east, and it was determined to erect wooden barriers (called groynes) stretching from the cliff to low water mark. The origin of the term groyne was very obscure. The inhabitants accordingly, being too poor to provide the money for erecting groynes, in 1722, by virtue of Letters Patent under the Great Seal, issued briefs by which collections were made in the various churches and chapels throughout the County for this object. About £1,700 was raised, and, aided by local contributions, the town was protected as far as the Steine.

During the present century much has been done in the way of groyning, and the coast of Brighton, instead of being washed away, was advancing farther out to sea, and the concrete groyne opposite the Clarendon Hotel appeared to have had a very great share in the work of accumulating the beach to the west of it, which had rendered it possible to widen the King's Road once or twice. The effect of the groynes was somewhat peculiar; on their western side a great heap of beach was formed, while on their eastern side the beach was from 10 to 15 feet lower, and on this side the sea rushed up with great violence. This was specially noticeable in the heavy gale of March 12th, 1876. It might be considered whether this could not be obviated by making the groyne V-shaped or by putting posts or buttresses on the eastern side, which would break the force of the waves.

At the present time there seemed to be two weak places on the coast, viz., at Lancing and beyond Pevensey. He had an impression that the cause of the special attacks of the sea at these places was very similar to that of the sea on the eastern sides of groynes. The neighbouring promontories of Worthing Point and Beachy Head respectively acted very similarly to the groynes and collected beach on their western sides, while the sea rushed up on their eastern sides.

One of the most destructive storms during the present century occurred on November 22nd, 1824. A brisk wind sprang up at night from S.W., and increased all night. Towards daylight of 23rd it became extremely calm for a short time but increased with the tide. High water was at one p.m., when the gale was tremendous, and it continued without abatement till midnight. At Brighton the platform of the Chain Pier was washed away and forty houses between Royal Crescent and Kemp Town were washed down. The Arun and the Ouse overflowed their banks. At Littlehampton the sea broke over the beach and inundated the fields; the damage between there and Pagham was estimated at £15,000. At Pagham and Sidlesham great damage—loss £30,000. At Bosham the mud wall, which cost £20,000, was washed away, and at Emsworth the tide was three inches higher than was ever known. In conclusion, he must apologise for the somewhat archæological character of this paper, but he trusted that if as a record of "natural history" it might not be sufficiently scientific, it might be found of interest to antiquarians.

The **PRESIDENT** (Mr. Dennant), on behalf of the members, thanked Mr. Sawyer for his admirable paper, and expressed a hope that it would lead to an interesting and profitable discussion.

Mr. E. **WILLETT** pointed out that the tendency of earthquakes was rather to uplift than to sink the coast, but that it was pretty clear from observations which his father was making, and of which he could not say more at present, that the coast line of the county was gradually and very considerably sinking. Allusion was also made to the present theory of groyning, which he (Mr. Willett) thought was wrong. By adopting it, there was as much wash on the lee side of a groyne as there was beach on the windward. If the groynes were made to lean a little to the south-west, kept very low, built up as the beach accumulated, and constructed in zig-zag fashion, a natural barrier to the sea would soon be secured. These were ideas of his father, and had been successfully enforced elsewhere.

Mr. **WONFOR** remarked that it was believed the whole of the southern coast of England was sinking, and that the time would come when Brighton and the adjacent low-lying parts would return to the sea. This prospect was so alarming to some people that one gentleman whom he knew had determined not to purchase a house on the Brighton Cliff, being convinced that although he should not witness the disappearance of the coast-line, his grandchildren might. Encouragement for such a conviction was offered in the fact that within the memory of some old people there were two roads from Brighton to Rottingdean south of the present. The silting up of rivers and harbours in this part of the country was also referred to; and it was predicted that either greater local energy than was at present shown in endeavouring to protect the land against the encroachments of the sea would have to be shown, or Government would have to do something in the matter, or the fears of those to whom allusion had been made would prove well grounded.

Mr. G. D. **SAWYER** re-directed attention to the silting up of rivers.

Mr. J. E. **HASELWOOD** suggested that there must be a peculiar set of currents at work in the English Channel, which had something to do with the change in the coast-line.

With Mr. Haselwood, Mr. C. F. DENNET agreed, and expressed his belief that a high, wide, and deep embankment, erected along the coast between the other side of Worthing and Newhaven, only would protect the land from the sea.

Mr. E. WILLETT pointed out that the cost of such an embankment would be too much for the town or county to bear, that the country would not be inclined to take the matter up, and that, providing a granite wall was built, the sea would in course of time break through it. The only effectual remedy against the encroachment of the water was a proper system of groyning.

Mr. WONFOR referred to the site of old Brighton. His belief, framed from the examination of old maps, was that it was between the Pool and West Street.

The CHAIRMAN made an enquiry concerning the rate at which wind travelled; and was informed by Mr. F. E. SAWYER that the rate varied from seven to eighty-one miles an hour in this country, and one hundred in India.

Mr. G. D. SAWYER alluded to the position of the Shoreham Harbour Pier. His belief was that if the Pier ran more to the south-east than it did the deposit at the Harbour entrance would be a thing of the past.

In his reply, Mr. F. E. SAWYER agreed with Mr. Willett as to the position and shape of the groynes, adding that they should be erected in pairs.

DISCOVERY OF ROMAN REMAINS AT PRESTON.

Mr. WONFOR, calling attention to a number of articles on the table, said that on the hills to the northward of Brighton, Roman and Romano-British remains, in the shape of urns, coins, fibula, &c., had from time to time been found. Round Hill-crescent and Wellington-villas had again and again given Roman coins and Roman pottery, as well as Romano-British pottery. Between the Ditchling and Lewes-road, urns and pottery had often been found, while westward, as far as the Cambridge-road, a Romano-British urn, containing bones was found a few years since, and with urns from the Lewes and Ditchling-roads, might be seen in the Brighton Museum.

It was, therefore, not to be wondered at, that building operations on an extensive scale to the north of the town—as are about to be commenced just beyond the Viaduct, on the ground laid out by Mr. Alderman Ireland and Mr. Councillor W. Wallace Savage—that they should bring to light proofs that at a far distant day Romans and Britons lived and died and buried their dead in what till recently was but so much land given over to cultivation, and deemed, except in this respect, virgin land. It was now some three weeks since workmen in the employ of Messrs. Ireland and Savage, who were engaged in digging flints, came upon what seemed holes full of flints and broken pieces of chalk, extending some 6ft. or 7ft. down to the Coombe rock. These pits, which had evidently been excavated and filled in, yielded about three times the number of flints, and these not rolled ones, as the ordinary diggings produced. One day an almost perfect skeleton of a man was found, at about three feet deep below the surface, and then the idea gained ground that they had come upon a graveyard, and that these excavated and filled in pits were graves. Now it was a well known fact that in some countries, at the present day, savage man, to protect the bodies of his departed friends, and to prevent the wild animals and especially the hyænas from tearing up and devouring the bodies, filled in the grave not with earth, but with stones.

The bones of this body were more or less in a very friable condition; the skull, when first found, was nearly perfect, and the teeth, the part of the human and animal frame to last the longest, were well preserved. This and the bones of another skeleton, for the portions of two human jawbones in the Museum evidently belonged to different people, were what is called secondary burials, *i.e.*, the interment had been made in a grave already occupied. There was this peculiarity with the teeth of one jaw, viz., molars, canines, and incisors are all ground flat on their crowns, showing that the teeth were what is called edge to edge bite, or were ground flat by the nature of the food.

These remains threw no light upon the date of the secondary burial. It might be remarked that the almost perfect skeleton was lying with its feet to the east and its head to the west.

At a lower depth, and resting on the Coombe rock, particles of of pottery were found of Roman and Romano-British types; around and among were more bones, and teeth of the horse and wild boar, with a tusk of the latter, burnt clay and charcoal, but no human teeth or bones. Some of these pieces of pottery he picked out of the graves, and by the orders of Mr. Alderman Ireland and Mr. Councillor Savage they were sent to the Museum, whilst strict injunctions were given to the men, if anything in the shape of pottery or metal were found, to send them also. It should be mentioned that a portion of the shell of a river mussel was found amongst the débris, at a depth of six feet.

The graves, for there have been some seven opened, lay nearly east and west—one grave was double—extended down to the Coombe rock, and were filled in with angular flints, broken pieces of chalk, and dark-coloured earth. The flints, some of considerable size, might have been collected on the surface, but the chalk must have been brought from some little distance.

Up to this point there was nothing to fix the date, except that the fragments of pottery were similar to that from the Romano-British graveyard at Hardham, or the various urns found around Brighton; but a well-preserved brass or bronze coin, about the size of a modern penny, but nearly double the thickness, proved that the interments could not be more than 1,700 years old. This coin had been identified as one of the Empress Lucilla, daughter of the Emperor Marcus Aurelius and Faustina the younger, whom in her wantonness she resembled. Lucilla was first married to Lucius Verus, the adopted brother of Aurelius, who was associated with him in the Empire, and who died A.D. 169 of apoplexy, while marching against the Marcommanni and Quadi, the modern Bohemia and Moravia. Within seven months of her husband's death, a woman being deemed during the Republic infamous who married again under ten months, she married Claudius Pompeianus.

Upon the death of Aurelius in 180 A.D., Commodus became Emperor, and, according to Gibbon, it was the act of Lucilla which made this Emperor a tyrant. In 183 A.D. an attempt was made on the Emperor's life; the plot, as Gibbon says, "had been formed not in the State, but within the walls of the palace. Lucilla, the Emperor's sister, and widow of Lucius Verus, impatient of the second rank, and jealous of the reigning Empress, had armed the murderer against her brother's life. She had not ventured to communicate the black design to her second husband, Claudius Pompeianus, a senator of distinguished merit and unshaken loyalty; but among the crowd of her lovers (for she imitated the manners of Faustina) she found men of desperate fortune and wild ambition, who were prepared to serve her more violent as well as her tender passions. The conspirators experienced the rigour of justice, and the abandoned Princess was punished, first with exile and afterwards with death." As the bronze coin of Lucilla was probably struck between 161 and 169 A.D., or not later than 180 A.D., the date of the primary interments could not be further back than the latter end of the second century, so that these graves of Roman or Romano-British origin were not of more remote antiquity than the beginning of the second century of Roman occupation. At that time Hollingbury Castle, less than a mile and a half away, was a Roman fortified camp. The hamlet of modern Preston, or Priest-town, might have been the site of a Roman village, while the portion of ground just opened and close to the little stream which emptied itself at that early period into the Pool (the modern Pool Valley) of early Brighton, might have been a grave yard removed some distance, as was the custom of our forefathers, from human habitations.

One curious circumstance should be mentioned—the finding a portion of what appears to be a wall composed of flint and mortar, at a depth of some five or six feet. This, at present, was an unexplained mystery, unless the monastery, said to belong to Preston, was situated near this spot. Further excavations might reveal other and more certain evidences, but what had been turned up clearly established the existence of several early graves in an unsuspected place, and confirmed the often-made assertion that the whole island gave evidence of Roman occupation.

June 22nd.

MICROSCOPICAL MEETING.

The evening not being devoted to any special subject, slides of various objects were exhibited; amongst the most novel, if not most interesting, of which were some diatoms and foraminifers dredged up, at a depth of 3,000 fathoms, in the Pacific Ocean during the recently concluded expedition of the "Challenger," and presented to the Town Museum by Lieut. Carpenter, son of Mr. Charles Carpenter, of Brunswick-square, who, Mr. Wonfor explained, in introducing the specimens to the members' notice, had for some time the charge of the dredger.

The nodules of manganese dredged up at various depths in the Pacific were also exhibited. These were of small size,—smaller than a chestnut, which they resembled in colour; but he had been informed by Lieut. Carpenter that they varied in size from that of a pea to that of a man's fist, or even larger. When broken up, they were, in almost every case, found to contain either a portion of bone or a shark's tooth. This fact was important, as it indicated that there were formations going on at the bottom of the ocean about which geologists were but slightly informed. One tooth, found encrusted in manganese in this way, measured 4½ inches in length; and he was given to understand that no sharks having teeth of such size had been met with in recent times.

In reply to Mr. Dennet, Mr. WONFOR said that, having had the nodules in his possession but a few hours, he was unable to say what relation the manganese bore to the manganese of commerce.

These nodules might help in explaining how iron nodules (commonly called thunder-bolts) and flints were formed in the chalk.

The meeting then became a Conversazione.

SEPTEMBER 14th.

ORDINARY MEETING.—MR. E. A. PANKHURST ON "SOME OF THE PROBLEMS CONNECTED WITH THE DEPOSITION AND CRYSTALLIZATION OF SILICA."

The substance, silica, which formed so large a part of the crust of the earth, was the oxide of a semi-metallic body, which was called silicon or silicium. On account of the difficulty of isolating it from its compounds silicon was one of the curiosities of chemistry. It might be obtained as a brown amorphous powder. Deville has also succeeded in crystallizing silicon in "large beautiful needles of a dark iron-grey colour, reddish by reflected light." If this silicon be raised to red heat in the presence of oxygen it formed a white pulverulent substance —silicic oxide. A large quantity of it was on the table before them. It was to the problems connected with the occurrences of this substance in Nature in a state of greater or less purity, to the marvellous and beautiful forms which it assumed, and to its relations with other bodies with which we find it closely connected, that he desired to call their attention that evening. It would be evident that unless we knew some of its more salient *chemical properties* we should be groping blindly in the dark—we should be building on an insecure and unstable foundation.

The following then were a few which it behoved them well to consider. This oxide of silica, natural as well as artificial, was insoluble in water either hot or cold. All the acids, with one exception (hydrofluoric), were incapable of dissolving it. If water contained in solution any alkaline carbonate— such as carbonate of soda or carbonate of potash—then this silica was dissolved to a slight extent. In a hot solution and under pressure the quantity dissolved was greater, and when the liquid was cooled and the pressure removed, the silica was deposited as an opalescent jelly. In aqueous caustic potash or soda it dissolved to a large extent. Water which had carbonic acid in solution, would also dissolve siliceous rocks when under the influence of considerable pressure. Struve had by this means been able to imitate many kinds of mineral water. Alkaline chlorides had also a solvent effect on silica, though not to a great extent.

And here he must beg them to notice the smaller bottle before him, which contained gelatinous silica. Flint jelly would not, perhaps, be an inappropriate name for it, as it was made from a flint. This was silica, united with the elements of water : hydrated silica. It was slightly more soluble in all solutions than the white powder from which all water had been driven. This distinction of solubility also occurred in Nature, and the hydrated was termed opal-silica. It was not met with in a crystalline or semi-crystalline form, that which was he would term quartz-silica. The distinction between the two was not absolute, but would serve their purpose for the time. Further, the oxide of silica was termed also silicic acid. For this reason. If carbonate of soda be melted, and if while in this state powdered flint be added to it, a slight effervescence was caused : the silica united with the soda, discharged the carbonic acid, and formed a silicate of soda.

What now was the bearing of these facts on the silica which was found dissolved in the water of rivers, springs, and lakes. We are not surprised to find that the water of Loch Katrine, though its tributaries might have run for miles over rocks containing from 60 to 70 per cent. of silica, contained not one part in a million (by weight) of this substance, while, on the other hand, that from Trafalgar-square, coming from the chalk and holding in solution alkaline carbonates and chlorides, contained 13. Bearing in mind that a hot alkaline solution was capable of dissolving large quantities of silica, we saw how it was that the mineral waters of Vichy, highly charged with carbonate of soda, contained 122 parts in a million, that the water of Plombieres after passing over Roman cement deposited in their efflux *opal.* Having learnt from experience that water charged with carbonic acid could dissolve silicates, we were not surprised to find that Karlsbrunnen in Silesia, which contained 406 cubit centimetres in a litre of carbonic acid, should hold dissolved 72 parts in a million of silica. Knowing that pressure and heat were alike favourable to the solution of this substance, we learned the cause of the splendid stalagmites of opal-silica round the Geysers of Iceland, and the terraces of the same substance, 300 feet high, round those of the Colorado district. Before them was a fine specimen of this hydrated silica from the great Icelandic Geyser.

Although as a rule an analysis of sea-water discovered to them but a very small proportion of silica among its constituents—seldom amounting to more than a trace, though in one case (from the English Channel) it rose to 16 parts in a million—yet the existence of diatoms in enormous quantities in some parts of the ocean was an important fact with regard to its presence. It had been found in even large proportions in the ashes of sea-weeds. Those of the common *Delesseria Sanguinea* yielding no less than 12 per cent. of this substance. The fact, however, of siliceous sponges, such as the beautiful Euplectella, composed wholly of pure silica, growing at the bottom of the sea, spoke louder than any analysis, as to its being, at any rate in some places, more perhaps than in others, an important constituent of sea-water. Professor Wyville Thompson in the cruise off the north coast of Scotland procured no less than 40 *vitreous* sponges in one haul of the dredger.

And now he would call particular attention to some extracts from a paper by the same distinguished man on "The Challenger" expedition (vide *Nature* of December 10th, 1874). They were doubtless aware that in the soundings of that expedition the calcareous Globigerina ooze was found to disappear at an average depth of 1,800 fathoms and to be replaced at greater depths by a red clay made up principally of silicates of iron and alumina. "There seems to be no room left for doubt that the red clay is essentially the insoluble residue; the ash as it were of the calcareous organism which forms the Globigerina ooze after the calcareous matter has been by some means removed. In this ooze siliceous bodies, including the spicules of sponges, the spicules and tests of radiolarians, and the frustules of diatoms occur in appreciable proportions; and these also diminish in number, and the more delicate of them disappear in the transition from the calcareous ooze to the red clay. All sea-water contains a certain proportion of free carbonic acid, and Mr. Buchanan believes that he finds it rather in excess in bottom water from great depths. I have already alluded to the large quantity of nodules of the peroxide of manganese which were brought up by the trawl from the red clay area on the 13th of March. Any large organic body, such as a shark's tooth, that may happen to be in the ooze is more or less completely replaced by manganese; and any inorganic body, such as a pebble or a piece of pumice, is coated with it. . . . At Station 160 the trawl brought up nearly a bushel of nodules from the size of a walnut to that of an orange." And this they should remember notwithstanding that the highest analysis of manganese in the ashes of sea-weed gave only 4 per cent.

No one could speak of the depositions of silica without taking into account one of the most striking examples of it—a flint nodule; and since science, like Charity, should begin at home, it behoved them especially to take them into account. *Chemically*, flint consisted of about 97 per cent. of silica, 1 per cent. of alumina and oxide of iron, about 2 per cent. of water, and commonly carbonaceous colouring matter. Of silica, a certain (varying) portion was soluble or opal-silica. Physically, flint might be briefly defined as a hard, semi-opaque, amorphous variety of silica with conchoidal fracture. It was never found crystalline or with mammillary or radiate structure. The first thing which struck an observer in our chalk quarries and cuttings was that the flint lay in layers. Dr. Mantell accounted for this by supposing that streams of water highly charged with siliceous matter streamed at intervals over the bottom of the sea, involving numerous small organisms, which became fixed in the subtranslucent flint precipitated from it. Although this theory was no longer held, no other had, as far as he was aware, been propounded satisfactorily to account for them. Personally he looked to the result of recent expeditions to throw light on the subject, as showing us the conditions of temperature, depth of water, &c., which were more favourable to the development of siliceous organisms than of calcareous ones.

Professor Thompson says, in the paper from which he before quoted, "On the 4th of February the tow-net dragging a few fathoms below the surface, came up nearly filled with a pale yellow gelatinous mass. This was found to consist entirely of diatoms." When full accounts of "The Challenger" and Arctic expeditions were published, they would probably be better able to theorize on these flint-layers. But now as to the origin of those flints and the singular phenomenon they presented. We found them of almost all possible shapes, tabular, spherical, pear-shaped, branched, solid, hollow, stratified. We found the siliceous substance filling the tests of Echini; solidified round pieces of wood, shells, sponges, &c.

From the splendid collection of flints which Brighton owed to the industry and beneficence of Mr. Henry Willett, he had taken the striking specimens before them to illustrate their growth in all its singular and interesting phases. Time would not allow him to notice one-hundredth part of all that was worthy their attention there. He must confine himself to one or two salient points in their structure. Take the case of one of those solid spherical nodules which were not uncommon. Under the microscope a section of flint often presented to us a mass of siliceous or silicified organisms cemented by siliceous matter. He quoted the paper of Professor Thompson to show the power of sea-water to dissolve—and therefore to hold in solution—carbonate of lime and silex. They would remember also his account of those nodules of manganese. Had these particles of silica a like power of forming nodules by aggregation? "I am reminded," says Mr. J. E. Taylor (Story of a Piece of Chalk), "of the way in which the siliceous material would separate from the limy mud by a process which goes on in the manufacture of pottery. When the ground flints have been reduced to a fine powder, and then mixed with clay in the soft putty-like condition, there is a tendency in the silica to separate from the rest and run together into nodules. It was necessary to prevent this by constant agitation."

Here, at anyrate, might be a possible solution of the growth of a flint nodule. No one could examine a collection of flints without being struck by the fact that organic matter had been a most active agent in causing the precipitation of silica from its solution and so of determining the forms of flints. They were well aware what a large part sponges had borne in their formation. Sponges were generally developed in a gelatinous matter, and it was an interesting fact that in an artificially prepared solution of silica, one of gelatine immediately brought about a coagulation of it. Organic substances in their decay evolved carbonic acid. A few bubbles of this gas passed through a solution slowly brought about a coagulation. There is no body with which silica seemed to have so much affinity as a compound of iron. The red stains in flint bore witness to it. A solution of ferric oxide also rapidly precipitated the silica from its solution. Had time not been so short he should have had great pleasure in showing them some of these experiments. To the power which silica possessed of replacing carbonate of lime, and on which Professor Rupert Jones laid so much stress in the formation of flints, he could not do much more than briefly allude. The most interesting problems in the study of these bodies were to be found connected with hollow flints. Here the silica had been deposited round a more or less perishable or soluble substance, which, subsequently or contemporaneously with the deposition of the silica, had been removed. But there was one general law connected with them, viz.,—that whenever the purer crystalline or semi-crystalline varieties of silica occurred in connection with flint, they were always found in the *interior* and never on the *exterior* of it.

Chalcedony differed from flint but slightly in its chemical constitution, but largely in its structure. It was mammillary, botryoidal, stalactic, with radiating fibrous lines at right angles to the plane of deposition. It generally occurred lining or filling cavities in rocks. Varieties of it were Beekite, Carnelian, Chrysoprase, Onyx, Agate, &c. Specimens of these were before them, mostly from his own collection.

He should confine himself, however, to the first and last of them. The first, Beekite, was interesting as displaying the mammillated structure with concentric and semi-concentric rings, and as replacing to a great extent the limestones on which it was formed. In process of time the limestone decayed, and a hollow siliceous crust remained. The Beekites were found in great numbers in the Triassic conglomerate of Devonshire. Professor Rupert Jones (Proceedings of the Geologists' Association, Vol. iv., No. 7) traced to a similar cause the origin of the potato-stones found in the Triassic breccia of Somersetshire. They had a siliceous geode, the interior of which was lined with quartz crystals; these last being formed from the siliceous solution which filled the cavity after the limestone was removed. Some of the most beautiful masses of chalcedony were those rounded pebbles found on the Sussex coast, and wrongly termed moss-agates. For, as Professor Jones remarked, they were not agates, and contained no moss. The problems connected with them for which he *wanted* solutions were—Whence do they come? Are they ever found in the chalk? How are they found, in geodes or hollows of flints, or are they independent concretions? Is the large quantity of oxide of iron associated with them an accident or a necessity of their existence?

"Agates are either solid nodules of chalcedony, usually in more or less concentric layers, or hollow nodules of the same (geodes) with crystallised quartz coating the inner surface (druses) or filling the middle. The central quartz is often amethystine." Briefly, an agate was formed in this wise. Take the case of a highly vesicular lava. The cavities were formed when it was in a fluid or plastic state by the steam and gases which were developed within it. Most so-called igneous rocks contained such cavities to a greater or less extent. Irregular cavities were also formed as the rock contracted in cooling. Liquids holding silica in solution found a resting place in these hollows and deposited the silica. By and bye the rock decayed and a banded mass of chalcedony and quartz crystal was left behind, being more durable than the rock. In illustration of this process he had brought some exquisite little agates still *in situ*, from the basalt of the great Teesdale dyke.

Among the highly interesting problems connected with these was the cause of their banded structure. These bands offered unequal resistance to the solvent powers of hydrofluoric acid and to alkaline solutions. They were often concentric, generally curved, seldom in straight lines; sometimes in beautiful folds, at others angular like the bastions of fortifications. Not less varied than their forms were their colours. How were we to account for the successive differences in the molecular constitution of the agatescent matter? A portion of every agate consisted of soluble or opal silica. Was it the varying strength or heat of the solution out of which it was formed which caused these differences of crystalline structure? Was it the intermittence of supply of fluid injected or infiltrated into the cavities? Dana laid great stress on this as the cause of banded structure. Mr. Ruskin, in his beautiful and exquisitely-illustrated memoir on Agates, in the fifth volume of the Geological Magazine, attached little importance to it. He saw rather in the agate a battlefield of crystalline energies; these, however, modified to some extent by conditions of deposition. And truly, when we looked at these pisolitic, concentric, and hemispherical depositions of chalcedony in the Beekite and marked the circular and semi-circular lines of the agate, and often, too, the tiny nodular concretion in the centre of these, we could not but allow how much crystalline energy was involved in the structure of a banded agate.

On the other hand, there were two specimens before them in which the original orifices of infiltration were still apparent, and in which, too, it seemed that periods of intermittence in supply, strength, chemical constitution, perhaps temperature, of infiltrated or injected liquid, are strongly marked. In one of them, also, the action of gravity in determining the direction of the parallel lines seemed undeniable. The porosity of agates was also remarkable. Most that were met with, 99 out of every 100, were in some manner coloured. Generally the agate was boiled for some time in a solution of sugar. This being absorbed by it, the stone was put into oil of vitriol—strong sulphuric acid—which decomposed the sugar, and, by depositing the carbon in the pores of the pebble, gave it the dark colour which was supposed to be admired. By dyeing them blue, the generally honest Swiss was enabled to palm off a piece of coloured agate on the unsuspecting traveller as a genuine bit of lapis lazuli.

Having spoken so much of opal-silica, he could not leave the subject without reference to it in its purest natural form. It might be defined as amorphous translucent silica, with resinous fracture and essential water. It was never pisolitic or reniform in structure. Distinguished also, from other forms of silica by lower specific gravity and greater solubility in solutions of potash. Its beautiful colours resulted from reflection and refraction of light produced by peculiarities of structure. There were several examples on the table, differing slightly from each other in purity, &c. A fine example of precious opal, *in situ*, from the porphyry of Czernewitza in Hungary, would explain well how it had been formed by infiltration in cavities much in the same manner as agates. A box marked Tabasheer was interesting, as containing specimens of this singular opal, formed in the interior of the stem of the large Indian bamboo.

And now that he had followed the struggles of silica, as it were, in its way through the world, he had but little time left to devote to a consideration of the splendour of its builded geometry, the beauty of its crystalline rest. Various as the forms before them might appear they were all derived from the six-sided prism terminated by a hexagonal pyramid. This was the ideal form which, though it seldom arrived at, it ever sought to gain. Seldom was the impurity so great, the obstruction so marring, impulse from within so wayward, or limitation without so repressive, but we could trace some element of that more perfect form to which, under happier circumstances, we knew it would have attained. The opacity of some of the crystals was due to the air-bubbles which had been entangled with them in their rapid crystallization. The colour of many of the specimens was owing to oxide of iron, of others to titanic oxide; of the beautiful rose-quartz, to manganese. The delicate purple of the amethysts was too evanescent for satisfactory analysis. As interesting to him as the form and colour were the substances which we found enclosed in these crystals. Rutile, mica, hornblende, and epidote were among the most frequent of these enclosed substances. It was singular that while in chalcedony dendritic formations of peroxide of manganese were so often found, they were rarely met with in rock crystals. They would look in vain among that case of specimens for dendritic structures such as were enclosed in the bits of limped and opaque chalcedony. In conclusion, in writing this paper, he hardly hoped to add to the sum of human knowledge; but if he had succeeded in awakening an interest in a subject, the study of which had been to him a source of infinite pleasure, he should be more than satisfied.

Throughout, Mr. Pankhurst illustrated his remarks by numerous and valuable specimens.

The **President** (Mr. Dennant), in thanking Mr. Pankhurst for his very entertaining paper on a vast and interesting subject, said he did so the more heartily, because it was only ten days ago that he waited on Mr. Pankhurst, on his return from Switzerland, and besought him to give them a paper. He was sure, therefore, that the members would show their appreciation of the way in which the request had been responded to by amply discussing the subject of the paper read. He saw several gentlemen present who were fully competent to sustain such a discussion, for the paper really covered a vast area.

Mr. **Henry Willett** said he begged personally to express his great satisfaction and to convey his thanks to Mr. Pankhurst for his paper. It only showed how sometimes people might live close together in a large town, and yet not know that they were engaged in congenial pursuits. He had great pleasure in making Mr. Pankhurst's acquaintance, and he hoped and believed that it would ripen into a friendship. It was curious that he (Mr. Willett) had been groping about in a field, hoping to ascertain some facts which might throw light on the interesting subject of how chalk flints were deposited, and that whilst he had only been able to get together the specimens, Mr. Pankhurst had, in his laboratory, been enabled to explain many phenomena which to him were mysteries. He was sure that many more discoveries would be made on the subject. He had been induced to take up the special subject of flints from having casually picked up some specimens which seemed to him rather to bear upon a theory which, two or three years ago, he should have scouted as an impossibility. He did not now say that it was a fact, but that it might be so. It was a theory of great interest, and he hoped some members of this Society would not neglect in their walks abroad to pick up the flints they saw, and see if any discovery could be made which would throw light on the matter.

The question was this—Were the flints now in process of increasing their size? He did not mean to say growing in the sense that men grew; but he had rather an idea that there was still going on, in the chalk around them, a process by which the soluble silica disseminated in a mass of chalk,—which varied in relative quantity, he was told, from two to four per cent.,—was gradually being dissolved by rain water, or water charged with carbonic acid, or some other chemical product derived from the chalk—in small quantities, no doubt, but still being dissolved, and afterwards redeposited around the nodules. He was heretical enough to say it was possible—nay, that he believed it was a fact, though he could not prove it—that many of the nodules they saw were annually getting larger. He thought there was no one who had ever studied the fissures filled with tabular flint but must come to the conclusion that they were of much more recent date than the nodular flints. Fissures seemed to have been formed by the subsidence of the chalk, and these fissures seemed to have been apparently filled up by that hard material called flint. The study of the tabular flints in the neighbourhood would be a source of great delight, and the student would be also enabled to gather facts which might tend to throw some light on the mystery enshrouding their formation, and upon the question as to whether they were still forming. This was a point about which he wished to interest the members of the Natural History Society. Were any facts now to be obtained to tell them whether or not flint is still forming in the chalk? He believed it was, and although he was not prepared to prove it, yet he hoped that they might possibly be able to do so.

Mr. J. E. HASELWOOD: You could not suggest any test? That is the difficulty, I suppose?

Mr. WILLETT said he thought the tests must be such as would commend themselves to each individual mind. He had, in his own mind, suggested that if any one could get into some subterranean place, such as the Brighton Waterworks, and if one could extract a flint, and put a gold or silver thread round it, replace it, and then examine it after a certain time, they might ascertain if there were any change. There might, however, be methods in the laboratory, for reaching the same end, by subjecting a block of chalk (which had been previously weighed) to the percolation of water, or of different kinds of water, to see if there were any change produced in that way. He would suggest, too, that, perhaps, if certain portions of chalk containing portions of tabular flint,—which in some cases were to be found as thin as note paper,—could be placed in the laboratory, and subjected to the percolation of water, with, perhaps, the addition of some little weak galvanic or magnetic force, some discovery might be made. He wished it to be understood that he was quite ignorant; it was merely a problem, in the solution of which everyone had the same opportunities as he had; and it was one in which he wished to excite an interest. He had himself certainly ascertained that thin fissures in flint were filled up with a kind of chaldeonic deposit, which was certainly of a more recent date. Pure blue films of chalcedony were constantly found in flints.

Mr. W. **SAUNDERS** said he did not know whether Mr. Pankhurst had observed that crystals had the power of replacing damaged angles.

Mr. **PANKHURST** replied that if the angle of a crystal were broken off while in the solution in which it had been formed, it rebuilt the damaged part with the same wonderful straightness and precision of angle which it originally had. The damage was as completely obliterated as, in course of time, was a slight cut upon the body.

Mr. F. **MERRIFIELD**: Will there be a scar left?

Mr. **PANKHURST** said that very often no appearance of the rebuilding could be noted; but that sometimes there would be where probably the solutions had differed in power.

Mr. B. **LOMAX** said he remembered that, when at the gold diggings, it was always a problem, in days past, as to how best to extract gold and other substances, including silica, from quartz, at the least possible cost, and with the least possible labour. He was now anxious to know what form the smooth, hard, and transparent coating took which covered grassy plants.

Mr. **HASELWOOD** said that Dr. Carpenter informed them that the vegetable bark of grasses might be burned away, and that the silica would then remain in threads.

Mr. C. F. **DENNET** said silica was a component part of almost everything in Nature, and was a source of great trouble to the manufacturing merchant, who had to get rid of it from the raw material out of which stuffs and paper were manufactured.

Mr. **MERRIFIELD** asked—Supposing silica, in the gelatinous form, found its way into a cavity in sufficient quantity to fill it, when that which distinguished the gelatinous silica from flint was parted from it so that nothing but flint remained, what proportion of the cavity would be represented by flint?

Mr. **Pankhurst**, in reply, said the question was somewhat indefinite, but he remembered it to have been stated by one authority that the proportion was about 15 per cent. When that point was reached, coagulation set in.

SEPTEMBER 28TH.

MICROSCOPICAL MEETING.—"POND LIFE."

Various objects illustrating Pond Life were exhibited by the President (Mr. J. Dennant), Mr. Haselwood, Mr. R. Glaisyer, and Mr. E. Glaisyer, but the most interesting were sundry specimens sent down for exhibition by Mr. T. Curteis, of Holborn, an Hon. Member: the principal were ***Argullus, Plumatella Repeus, Stephanoceros,* and *Praludicella Ehrenbergii.***

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER, 1876.

Abbey, H.
Ardley, W.
Aylen, S.

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Balean, H.
Beavan, J.
Bellingham, C.
Benifold, J. S.
Bigge, A.
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Booth, E.
Boxall, W. P.
Bright, E.
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Browne, Hon. Howe
Browne, G.
Busby, R. A.

Capon, J.
Carden, J., Jun.
Carpenter, Charles
Challen, J.
Clarke, A.
Clarke, W. T.
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Cobb, R.
Colling, J. W.
Cooper, T. J.
Corfe, Dr.
Cox, A.
Cox, A. H.
Creak, A.
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Curtis, J.
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Dawson, Dr.
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Duguid, I. I.

Eberall, J.

Felton, W.
Fisher, A.
Fowler, T. M.
Fox, O. A.
Friend, Daniel
Friend, D. B.

Glaisyer, J. H.

Glaisyer, R.
Glaisyer, T.
Glaisyer, E.
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Gwatkin, J. T.

Hack, D.
Haddock, G. J.
Hadlow, F. V.
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Hall, E. P.
Hallett, W. H.
Hallifax, Dr.
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Hamblin, W. T.
Hamilton, C. C.
Harris, E. H.
Hart, E. J.
Haselwood, J. E.
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Heald, C. J.
Henty, W.
Hilton, W.
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Holder, J. J.
Holford, F.
Holford, G.
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Holloway, A.
Hurst, H.

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Infield, H. J.
Ireland, A.

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Jackson, W.
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King, Dr.
Knightley, Dr.

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Lee, W. R.
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Lomax, Benjamin
Lomax, O'Brien
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Lucas, J. E.

Mahomed, F.
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Mills, P.
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Newton, Rev. J.

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Nourse, W. E. C.

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Ross, Dr.
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Saunders, W.
Savage, W. D.
Savage, W. W.
Sawyer, F. E.
Sawyer, G. D.
Saxby, —
Scott, E.
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Wilkinson, T.
Willett, E. H.
Willett, H.
Williams, H. M.
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Winter, J. N.
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Wood, W. R.
Wood, W. R., Jun.
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To Book and Periodicals		28	16	3
" Printing—				
Annual Report...	36 11 0			
Circulars, &c. ...	8 3 6			
		44	14	6
" Stationery, Postages, &c.		8	1	2
" Fire Insurance		0	12	0
" Bookbinding...		1	16	2
" Messenger for delivering Notices ...		4	3	0
" Commission to Collector for Subscriptions		3	3	6
" Assistant Secretary ...		1	10	0
" Donation to Assistants at Museum		2	0	0
" Expenses of Soirée ...		13	1	6
" Incidental Expenses		0	5	10
		108	3	11
" Balance in hands of the Treasurer		4	18	4
		£113	2	3

Cr.	£	s.	d.
By Balance from last Year	2	10	0
" Annual Subscriptions due September 1st, 1875	89	0	0
" Arrears due September 1st, 1874	6	10	0
" Entrance Fees...	15	0	0
" Sale of Copy of "Moss Flora of Sussex"...	0	0	9
" Sale of Annual Report	0	1	6
	£113	2	3

Examined and found correct,

GEO. D. SAWYER,
ROBERT GLAISYER, } Auditors.

October 12th, 1876.

THE TWENTY-FOURTH

ANNUAL REPORT

AND

ABSTRACT OF PROCEEDINGS,

OF THE

BRIGHTON AND SUSSEX

NATURAL HISTORY SOCIETY,

ADOPTED AT A MEETING HELD

ON THURSDAY, OCTOBER 11TH, 1877.

PRICE ONE SHILLING AND SIXPENCE.

Brighton:
PRINTED BY H. J. INFIELD, "SUSSEX DAILY NEWS" OFFICE.

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President:

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DR. HALL,
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12, North Street.

Committee:

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MR. DENNET,
MR. E. H. WILLETT,
MR. J. WILLS,
MR. ALD. HALLETT,
MR. A. DOWSETT.

Honorary Secretaries:

MR, T. W. WONFOR,
38, Buckingham Place.

MR. J. COLBATCH CLARK,
56, Middle Street.

Honorary Librarian and Curator:

MR. ROBERT GLAISYER,
The Dispensary, Queen's Road.

At the Twenty-fourth Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church-street, October 11th 1877,

IT WAS RESOLVED,—

That the Report, Abstract of Proceedings, and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the cordial thanks of this Meeting be given to the Honorary Secretaries, Honorary Treasurer, and Honorary Librarian, for their labours in preparing the same.

That the following gentlemen be elected as Officers of the Society for the ensuing year :—President: Dr. Badcock; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. Benjamin Lomax, Mr. Dennet, Mr. Ernest H. Willett, Mr. J. Wills, Mr. A. Dowsett, and Mr. Alderman Hallett; Honorary Secretaries: Mr. T. W. Wonfor and Mr. J. Colbatch Clark; Honorary Librarian and Curator, Mr R. Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

(Signed) GEORGE D. SAWYER,
Chairman.

IT WAS ALSO RESOLVED,—

That the warmest thanks of this Meeting be presented to Mr. Geo. D. Sawyer for his able conduct as President during the past year.

REPORT.

In presenting the Twenty-fourth Annual Report, your Committee have again the pleasure of recording the continued prosperity of the Society.

During the past year, two gentlemen who have been members of the Society since its formation, have died, and the Committee deeply regret their loss—Mr. T. B. Horne, who was one of the founders of the Society, one of the first Secretaries, and also Honorary Librarian, and on resigning the Secretaryship in 1858, was appointed Honorary Treasurer, which office he filled until 1874, when he was elected one of the Vice-Presidents of the Society; and Mr. F. M. D'Alquen, who took an active part in forming the Society and in supporting it for many years.

The financial condition of the Society is satisfactory. All its liabilities have been met, and a sum of £13 6s. 6d. has been expended in the purchase of new books and periodicals, and there remains in the hands of the Treasurer a balance of £7 4s. 4d.

The number of Members has slightly increased during the year.

Presentations of the following Books have been received during the year, viz.:—Report of Congrès International d'Anthropologie et d'Archeologie Prehistorique de la Swede, and five Numbers of the Quarterly Journal of the Geological Society (from Mr. Henry Willett); Index to Vols. 1 to 13, Dr. J. Lea's Observations on the Genus Unio (from Mr. Thomas Davidson): Copy of Paper "on certain living and fossil fishes," by Miss Agnes Crane, read at an Ordinary Meeting (from the Authoress): Descriptive Catalogue of the Birds in Mr. Booth's Museum, Dyke Road (from Mr. Booth); Dr. Carpenter on the Microscope (from Mr. Gwatkin); Paper on certain forms of Animal Life off the Norwegian Coast, by G. Ossian Sars; Transfusion, &c., by J. W. Müller, and Lists of the Insects of Norway, by H. Siebke and J. P. Scheider (from G. Ossian Sars); On the Brank, by Dr. J. Stevens (from the Author); Account of the Glacier Garden near Lucerne (from Mr. F. E. Sawyer); Report of the Smithsonian Institution for 1875, Geological Survey of Montana, by Dr. F. V. Hayden; Bulletins No. 1 and 2 of the Entomological Commission of the United States, by Dr. F. V. Hayden; Report on the Rocky Mountain Locust and other Insects, by Dr. A. S. Packard; First, Second, and Third Annual Reports of the Survey of the Territories and the Survey of Wyoming and the contiguous Territory, by Dr. F. V. Hayden (from the Department of the Interior, Washington, U.S.A.); Transactions of the Cumberland Association for the Advancement of Science; Proceedings of the Belfast Natural History and Philosophical Society; Annual Report and July, October, January, and April Numbers of Proceedings of the Geologists' Association; Nos. 33 and 34 of the Journal of Quekett Microscopical Club; Annual Report and Eighth Vol. of Proceedings of Cardiff Natural History Society;

Report of the School of Mines, Ballarat; Part 1, Vol. 3, Proceedings of Natural History Society of Glasgow; Fifth Annual Report of Croydon Microscopical Club; Annual Report of North Staffordshire Naturalists' Field Club; Sixth Annual Report of Chester Natural History Society; Part 1, Vol. 3, Transactions of Edinburgh Geological Society; Proceedings of the Eastbourne Natural History Society; Annual Report of Lewes and East Sussex Natural History Society.

The Committee desire particularly to record their thanks in acknowledging the continued liberality of the Government of the United States of America in forwarding many very valuable works on the Geography, Geology, and productions in Zoology and Botany of several of the States and Territories.

The following Books have been added by purchase during the year, viz.:—The Aquarium, its Inhabitants, &c. (by J. E. Taylor); Birds of Europe, 4 vols. (by C. R. Bree); Life of a Scotch Naturalist (by S. Smiles); Myxomycetes of Great Britain (by M. C. Cooke); British Aphides (by G. B. Buckton); Ray Society Pub.; Vol. XVI., Part 4, Botany; and Vol. XIII., Part 7, Zoology; Linnean Society; Wealden and Permian Reptilia (by R. Owen); Fossil Brachiopoda (by T. Davidson); Carboniferous Foraminifera (by H. B. Brady); British Fossil Ligoniæ (by J. Lycett); Eocene Bivalves (by S. V. Wood); Carboniferous Ganoid Fishes (by R. H. Traquair); Eocene Mollusca (by F. E. Edwards and S. V. Wood); British Fossil Elephants (by A. L. Adams); Mezozoic Reptilia (by R. Owen); Palæontographical Society's Pub.

The number of Books in the
of unbound Periodicals and Pamphl
Committee to report that use of
Public Free Library has much increa

A donation of four slides—two
Tissue infiltrated with different sub
from Mr. J. Curteis.

It will be seen from the List (at
Societies associated with this Society, a
are exchanged, that the Society is
throughout this country and also in An
have heard with pleasure that several
been read in this Society have been co
importance to be subsequently read bef
Societies in London.

Your Committee have offered a pri
collection of Wild Flowers found in the
the present year, to be sent in before th
upon certain conditions. They hope th
further promoting the study of Botany,
collection of the Wild Flowers of the Co

The Conversazione was held in the
1st of March, and was very successful, a
will be found in the proceedings.

The Field Excursions since the last
follows :—October, 1876, Hassock's Gate ;

June, Polegate; July, Lancing; August, Steyning; September, Henfield.

The Annual Excursion took place on the 5th of July to Pevensey, Hurstmonceaux, and Hailsham.

The thanks of the Society are due to those gentlemen who have read papers, exhibited objects, or presented specimens or slides for the cabinet, or photographs or drawings for the Society's album; and, in concluding their Report, your Committee would urge upon each Member of the Society to do what he can to further the objects of the Society and bring its merits before his friends.

ABSTRACT OF PROCEEDINGS.

1877-78.

OCT. 13TH 1876.

ANNUAL MEETING

The out-going President (Mr. Dennant) said it was customary for the President when he vacated the chair to offer a few valedictory remarks, and it was only fair to suppose that having had twelve months' experience in the conduct of the Society he would be in a position to offer some suggestions of a practical nature with regard to its future. He had, therefore, to ask their forbearance a few minutes while he endeavoured, in aquiescence with that custom, to bow himself metaphorically out of that position to which they did him the honour to elect him a year ago. He would not weary them by recapitulating the work of the year, but he might be excused if he summed it up—as he did with considerable pleasure—as a year of marked success as regards the character and quality of the papers which had been submitted to them; and he begged very heartily to thank those gentlemen who had read papers for their able contributions. To those kind friends who helped to make the soirèe such a success he also desired to express his sincere thanks. But he would not be doing his duty if he did not say that the microscopical meetings during the past year have not been so well attended as they should have been.

A certain few staunch friends have been most constant in attendance with their microscopes, and if a few more microscopists would take the trouble to bring their instruments, for the more thorough elucidation of the subjects under investigation, it would greatly add to the interest and usefulness of these evenings.

He could not retire from the chair without an allusion to the perfect harmony that had prevailed during the year—a result due not only to the good fellowship prevailing among the Members, but to the admirable manner in which the officers carry on the work of the Society.

When they thought of the untiring zeal of the officers in the interests of the Society, the many years of service they had rendered, and the conspicuous ability they brought to their respective departments of work, they would agree with him that the Society owed them a deep debt of gratitude, and on his own account he tendered to Mr. Wonfor and Mr. Onions, the Honorary Secretaries, and to Mr. R. Glaisyer, the Honorary Curator, his sincere thanks for the kind assistance they had severally given to him on many occasions during his period of office.

Those who had been long associated with the Society could not have failed to notice that they were gradually losing, from one cause or another, the presence of members who had helped in a marked manner to build up and adorn the Society—enthusiastic students of Natural History—whose places it would be difficult to fill. A little uneasiness was felt lest the Society from these losses should in any way sink into a less useful and honourable position. But he believed they had a sufficient number of able and willing workers amongst them to avoid anything like an immediate collapse; still he confessed that he felt some little anxiety lest further losses should so far impoverish the Society as to diminish its force and influence. Numerically they were strong and the numbers were increasing, but in this respect they somewhat resembled the tree that had made wood and leaf at the expense of its fruit. If this be so, the question naturally arose—How could the future health and stability of the Society be best insured? A reference to the laws of physiology would provide the answer.

He referred to the supply of the health producer and sustainer—the blood. They knew that without a rigid attention to the laws of hygiene, and a scrupulous obedience to the nutrient processes, the *vis vitæ* failed, and the powers succumbed to a premature decay. Assimilation must be constantly going on if a vigorous life was to be enjoyed. And in this Society, as one after another of its strong supporters was removed, they wanted the reanimation of young blood.

They had amongst their Members men of more than ordinary ability and culture, who are comparatively idle with regard to the work of the Society; they might help greatly if they would, and he trusted this reminder to absentees would spur them into action. But it was to the younger men, and the more recent Members, that he would chiefly address himself. Some of them had set an example to the rest by coming to the front with good and earnest work; but a considerable number had joined the Society, he suspected, more with the idea of receiving than of giving intellectual pleasure and enjoyment. Possibly from their own standpoint, their self-estimation led them to avoid taking a public part in the discussions of the Society, but from the Society's point of view they may be depriving it of much valuable assistance. A voluble tongue was but seldom associated with high intelligence, and might often prove a hindrance rather than a help to scientific discussion, whereas taciturnity in young men was often united to a precocious wisdom. To their taciturn young friends then he would say that the Society requires their aid.

Many of those who felt warmly to it, were quite unable to give it that helpful attention it required; they were hurried along by the pressure of busy lives into methods and habits of life which leave too little energy for scientific investigation, attractive though it be, and their work must of necessity be of a desultory character. But to those for whom life appeared a long and hopeful future, he would say—They had the power, as he hoped they had the will, of so arranging their spare time as to devote regular portions of it to intellectual recreative study, such as was embraced within the sphere of the Society's operations. Such a cultivation of the mind in early life would supply them with those delightful resources, for the leisure of later years, when men desire to relinquish their hold of their ordinary avocations, and when many a man found to his sorrow that he has few ideas, save those supplied by his ledger and his cash book.

The occasional but regular study and investigation of one or more departments of Natural History cannot but impart a healthy and beneficial tone to the mind, for the man that is dealing with and marshalling facts for the purpose of arriving at what is an exact scientific truth, must per force of such mental training, become a lover of truthfulness. George Eliot very aptly says that "Science is properly more scrupulous than dogma. Dogma gives a charter to mistake, but the very breath of Science is a contest with mistake, and must keep the conscience alive."

He was not asking them to devote all their spare time to Science. This would be neither reasonable nor desirable; neither was it advisable to give exclusive attention to one subject alone, be that subject even their source of living. He could not do better than recommend for their perusal a series of very able articles from the pen of Dr. Richardson on "National Health," appearing in *Good Words* for the last few months, so full of strong common sense and wisdom.

Speaking of the tendency there is of working in grooves, and attaining what is called perfection in special departments of Art, Science, and Literature, he says—"To some extent this division is perhaps a necessity, but carried into such minuteness as at present exists, it is hurtful beyond expression. The ideal of individual perfection in the performance of the one particular art or craft, without diversity of occupation,—that is to say, the devotion of a life to a single intent or purpose, is of all exercises the most ruinous to the vital nervous power. It brings the whole nervous energy into concentration upon special sets of the motor instruments of the body, and before maturity is attained the living man is transformed into an automatic mechanism, which becomes so distinctive that no other motion except that which the habit directs is tolerable. Limitation of view, limitation of knowledge, of thought, of sympathy, of muscular movement, becomes a second nature, and leads to dependence of one man on the other and others, until the perfect master in his own department is a helpless child so soon as he is out of his narrow sphere.

He hoped that in the remarks he had felt it his duty to make he had not assumed too preaching a tone ; such was farthest from his intention ; but he was aware that through the kindness of the Press (to which they were so much indebted for the admirable reports of their proceedings), his remarks might reach the eye of some of those absent Members of whom he was thinking and whose co-operation he was anxious to enlist. But some might say, " it is all very well to give us this advice, but we are mere tyros in Science, and we have no companions to lure us to these pleasant paths, and help us in our feeble efforts. " To such he would say that he believed there were gentlemen in the Society who would be willing to help them.

A most valuable suggestion, made some time since by their esteemed Honorary Secretary, Mr. Wonfor, for the verification of the fauna and flora of the county, namely, the establishment of sections for the study of various subjects, was so far carried out that they had three departments provided for at present, with a Chairman and Secretary for each, who were merely waiting for the co-operation of any Members who might thus wish to specialize their work. The subjects were entomology, botany, and vertebrate zoology. And he felt from what he knew of those gentlemen, that they would be very ready to welcome any students, and help them in the acquisition of even elementary knowledge upon these subjects. He would therefore urge them to enrol themselves and see what a winter's work would do to encourage them. Sectional work of this kind, successfully carried out, could not but be a great benefit both to themselves and the Society, and in a comparatively short time they would find themselves in the happy position of never having a dearth of papers or interesting discussion.

In conclusion, he thanked them most warmly for the kind consideration and attention they had paid to the chair during his occupation of it. In accepting the honour—one of the greatest honours of his life—he felt that, however incompetent, he ought not to shrink from doing what appeared to be his duty, and that he would try and do his best for the Society. He was fully conscious of having fallen far short of what he would wish to have done, but he had been sustained throughout by the thought that they would be generous enough to throw the mantle of charity over his numerous shortcomings. He, then, with great pleasure, asked Mr. G. D. Sawyer to assume the presidency of the meeting, for that gentleman took great interest in the work of the Society, and had been intimately associated with its management for many years; and he knew Mr. Sawyer would fulfil the duties of the office with ability and zeal, and he wished them health to enjoy its pleasures.

Mr. G. D. SAWYER, the new President took the chair, and thanked the Members of the Natural History Society very sincerely for the honour they had done him in asking him to preside over their meetings during the ensuing year.

He did not hesitate to acknowledge that he considered it a very high honour to be called to the presidency of a Society holding such an influential position in the town as the Brighton and Sussex Natural History Society does. This position has been a steadily but surely advancing one, and he felt warranted in affirming that the esteem in which it is held by their fellow townsmen is second to none, and is still increasing. Month by month had seen the increase of their roll of Members by the

addition of the names of men of
mind, bent upon the possession of
to them. Even that very evening
rule of steady increase—they had
Members from whose presence and
find benefit.

The information furnished to
meetings and miroscopical evenings
most interesting and instructive cha
variety. And as to their soirees—bu
it was acknowledged that they had
successes. But the very fact that all t
to the natural timidity with which one
bidding to attempt to occupy so pro
President of such a Society; and he as
and they would agree with him that he
the office if he did not feel—a heavy res
him as he yielded to their request and to

He had delighted, in his quiet, retire
Member, in listening with increasing enjo
and interesting facts and reasonings broug
their very able and efficient Members; an
him well still to have quietly retained thos
it was now their will that he should fo
enjoyable position of retirement, and take
prominent duty upon which he now ent
promise that he would fulfil the duties of the
his ability, stimulated by the consciousness o
accepting a positon that had been filled with
able men that had preceded him in the
whom he had the pleasure of seeing before
by an earnest desire that nothing during his
occur to tarnish the honour now resting upon
feel encouraged by the recollection of the sym

manifested with the efforts of those in office, and the unvarying kindness with which they had yielded all needful help to them in carrying out their duties; and he was sure they would stand by him in his effort to fulfil those duties. He had also been long enough among them to know how thoroughly he could rely on the indefatigable help of their esteemed Secretaries—a host in themselves! Would that their good friend, Mr. Wonfor, was entirely restored to his wonted health and vigour. But even this would, he trusted, prove true at no distant period, and that they would still have his cheery voice and quick wit animating them, and his valuable remarks instructing them in their meetings as they had so often done in times past.

If he might make two or three personal remarks he would venture to say that it was no new thing for him to be associated with those who were seeking by patient enquiry to obtain increased knowledge and elevate the mind.

If they would not smile at him for going back so far into the past, he would say that as long as thirty-eight years ago he was connected with a band of young men, meeting every week for mutual improvement in the offices, and under the presidency of one of the ablest solicitors of the town—the late Mr. William Penfold—at which they had each, in rotation, to read an essay. It might interest them to hear that one of that little band of students was Mr. Abbey, the now Mayor of the town, and that he had the pleasure at that time of hearing him read a very interesting paper on the steam-engine.

His pathway soon afterwards was across the ocean to North America, and five of the most active years of his life were spent in the United States with plentiful opportunities of observing the natural phenomena of that grand country, with all its busy life, its quick perceptions, and its noble aims. Splendid courses of lectures on physiology and other scientific subjects were being delivered in New York during his two years' residence in that great city, and, of course, he did not attempt to resist the strong attraction that such lectures had upon his mind, but attended them with great delight and lasting profit. Duty called him back to his native land, and to his native town of Brighton, and he soon found congenial spirits in the then flourishing Athenæum, and for many years, until its dissolution, occupied a place on its Committee, and for a time filled the office of Moderator in its Discussion Society.

Simultaneously with his efforts in connection with the Athenæum he was endeavouring to promote the success of the Young Men's Christian Association of this town as a member of its Committee, and was appointed (in conjunction with Mr. Henry Willett) as a delegate to the International Conference of Young Men's Christian Associations that met in Paris in 1855, during the period of the first French International Exhibition and the visit of our beloved Queen and Prince Consort to the capital; and last, though not least, for a period of twelve years he had had the great privilege of being a Member of their excellent Society, and in their midst had passed many of the happiest hours of his life, acquiring information that he was sure had elevated his mind, and becoming acquainted with the wonders of creative wisdom that had often led his mind from nature up to nature's God.

He must be pardoned if he had trespassed on their time and patience with these purely personal details, as he felt it due to himself, as well as to them, that he should, as best he could, justify his position in the presidential chair that night by showing that it was quite consistent with his whole past history—that whatever duty presented its claims upon his service in connection with an inquiry after further knowledge, his one principle had always been to accept that duty and to try and fulfil it to the best of his power.

By their help and relying on their kind sympathy, he now sat down, promising to do his best to fulfil his duty as President of their valuable and important Society.

Mr. J. E. HASELWOOD expressed his pleasure at seeing Mr. Sawyer in the presidential chair, and proposed a hearty vote of thanks to Mr. J. Dennant for his able conduct in the chair during the past year. The Ex-President he highly complimented for his constant attention to his duties, not being absent from one meeting of the Society during his tenure of office, he believed, and thereby showing that his heart was with them, and setting a praiseworthy example to other Members. He heartily wished that some of these would oftener appear at the meetings of the Society than they did, and not be content with merely reading the newspaper reports of these meetings at home. Much as the Society was indebted to the press for the admirable way in which it recorded their proceedings, the publicity it gave to them tended to lessen the attendances at their meetings. This was not pleasant to contemplate, for almost always something was cropping up upon which some Member could give the Society useful information. He, therefore, hoped the example of the Ex-President—and that which would, no doubt, be set by the new President—would be followed by many who had in the past been irregular in their attendances.

Concluding, he alluded to the difficulty which a President had to contend with in his endeavours to please every Member, and to the successful way in which Mr. Dennant had overcome that difficulty.

Mr. A. DOWSETT seconded the motion, supporting what Mr. Haselwood had said in praise of Mr. Dennant.

The CHAIRMAN also joined most heartily in the commendations accorded Mr. Dennant, and then

The motion was cordially agreed to.

The EX-PRESIDENT acknowledged the compliment, assuring the Meeting that the measure of success which had attended his efforts during the past year had been due to the support of the Members, and thanking the Members for that support.

This concluded the business of the Annual Meeting, and there followed an

ORDINARY MONTHLY MEETING.

Mr. A. **Bigge** presented to the Society, by letter, a painting of a sheldrake, by the late Prideaux J. Selby, of Turrell House, Northumberland, the author of "Selby's British Ornithology," who, the donor remarked, was an admirable artist, besides being a most learned naturalist.

Mr. A. **Dowsett** submitted for examination true and false specimens of the Colorado potato beetle, and explained that the "false" insect was not injurious to the potato, feeding on some allied plant. He also pointed out that there was a possibility of the "true" beetle finding its way to England from America—where the specimen submitted had been found—by being brought over the Atlantic in vessels laden with potatoes, especially if the potatoes were put into the vessels with the haulm of the plant.

The larvæ of the insect, being soft like maggots, were not likely to be brought over the water, as they would scarcely escape being crushed, either during the loading or unloading of the vessels. The differences between the "false" and "true" beetle were said to be that in the former the two lower black lines but one on each elytron, or wing-sheath, were united at the base, while the lines on the wing-sheaths of the "true" beetle were wholly separate and distinct, and that the "false" beetle was generally larger, brighter in colour, with fewer markings on the thorax than the "true" one.

The President, Mr. G. D. **Sawyer**, showed a sponge from the Phillipine Islands, North of Australia (*Euplectella Aspergillum*). It, he said, was only the skeleton of the sponge. In its living state the framework was veiled by a delicate gelatinous tissue. The texture had been compared to lace.

The Rev. J. HANNINGTON exhibited varieties of birds' eggs.

On behalf of his brother, Colonel Hannington, the Rev. J. HANNINGTON stated that the house and grounds of the former, at Hurstpierpoint, would be thrown open on Saturday to Members of the Society taking part in the Society's field excursion on that day.

OCTOBER, 26TH, 1876.

MICROSCOPICAL MEETING.

Mr. G. D. SAWYER, the President, showed, under the microscope, spinnerettes of spider, vegetable stellar tissue, spicules of gorgonia—section of skin from leg of an ox, a house fly—palate of a *trochus*, &c.

Mr. R. GLAISYER selected diatoms and other fine specimens.

Mr. GLAISYER, in the absence of the Hon. Secretaries, read an invitation to the Members from MR. HENRY LEE, F.L.S., Consulting Naturalist to the Brighton Aquarium, and the President of the Croydon Microscopical Society, to their annual soiree, on the 29th November. Mr. Lee had, the Chairman said, been a very kind and obliging Member of the Society, and he hoped that, consequently, many Members would regard it as a duty to respond to his invitation. He would take with him a microscope and show some interesting specimens.

With reference to their next regular meeting, he remarked that it happened to be fixed for the evening of the 9th of November—the night on which the next Mayor's inaugural banquet would take place—and as the Mayor-Elect (Mr. Alderman Lamb) had been kind enough to invite some of the Members of the Society to be present on the occasion, he would suggest that the regular meeting should be postponed for a week—till the 16th November.

It was unanimously agreed to act upon the suggestion.

NOVEMBER 16TH.

Mr. B. LOMAX, on—

THE CONSTANCY OF CERTAIN NUMBERS IN NATURE.

The subject of this paper is so different to those which are generally brought before you as to render some explanation, if not apology, necessary. In the earlier days of learning everyone knows how much importance was attached to the recurrence of particular numbers. The so-called science of Astrology was based entirely on the cycles in which history had been found to revolve, according so strangely with those recognised by the astronomer. The belief in a coming millenium, so interwoven with the history of the Christian church, seems to have had at first no better foundation than the continual recurrence of the number seven in Holy Writ, leading the earlier Jewish writers on theology to speculate on the possibility of this world's history being that of a mighty week, made of "a thousand years for a day," whose Sabbath was the millenium. In the field of Natural History, the uniformity of numbers was insisted upon from Aristotle to Bacon, who in his "Novum Organum," notices the supposed fact of the serpent family always arranging themselves in four curves. Nor were the Mathematicans slow to follow the fashion. With the Arabic numerals and the decimal notation came curious disquisitions on the properties of number nine, the formation of magic squares, and the series into which their sums arranged themselves. In fact, the study of series, arithmetical and algebraical, is our modern sacrifice at the same altar, and the results have been of the greatest practical utility. We cannot to-day pass by as foolish those who in earlier times observed recurring numbers. Kepler, whose name must ever stand high on the roll of astronomical fame, was no mathematican, no chemist, no inventor; he merely observed recurring numbers. Yet Kepler defined the place of an unseen planet that others were to discover in the form of a group, and established three laws which Newton afterwards proved mathematically—Newton, who was himself a student of numbers, and wrote much on the cycles of History as compared with those of Astronomy. Linnæus, too, was an observer of numbers, and his well known system of classification is founded strictly on numerical coincidence. The theory is artificial, but the result is not so, as the following groups are kept separate :—The Orchideæ, the Compositæ, the Labiatæ, the Scrophularinæ, the Ranunculaceæ, the Rosaceæ, the Umbelliferæ, the Cruciferæ, the Cyperaceæ, and the Gramineæ With such example before me, I need not fear to seek for constant numbers in Nature. To me, at least, it appears that what Nature has thought worth doing, I may well think worth studying. At any rate, as an old philosopher has said, "Homo sum, nihil humanum mihi alienum puto," I may fairly add "I am a naturalist; nothing natural is uninteresting to me."

In following the series of numbers from zero to infinity, we notice that the *prime* numbers, or those that contain no active factors, although they appear to follow no regular series, diminish rapidly in number. Thus commencing with 1, 2, 3, they drop off to 5, 7, 11, 13, and dwindle down to such *raræ aves* as 31, 37, 41. In our search we must likewise expect to find the smaller numbers most constant, and the larger ones rare, absent, or of doubtful value, as being repetitions of their factors.

Naturally we commence with Number One. And here I am obliged to confess a failure. The Naturalist seems to be in the position of Hood's Postman — "He hardly seems to know there is a Number One." After very careful thought, I am unable to find a single item of nature, animal, vegetable, or mineral, that can claim the place of unity. The seeds of certain plants are called monocotyledonous, but the case is merely one of partial abortion, as is proved by the plant being a strictly dual structure, with stamens and pistils. The Spores of the Cryptogamia have scarcely a better claim. Wherever the microscope has reached these little organisms the development of some form of sexual apparatus, of Archegonia and Antherizia has betrayed the dual character. If we trace down the animal to his original cell nucleus, we find an organism continually multiplying itself by fission—division into two—and thus here we have the same difficulty in saying that unity is reached. Even the mineral world fares no better, since all the modern chemists have agreed to represent the smallest portion of free matter by a molecule composed of two atoms.

When however we come to the consideration of Number Two, there is no difficulty in finding examples. All animated nature is dual. The smallest, simplest animal we know is symmetrical, having two sides alike. The Pleurobrachia may be taken as the type of the form of which the Annulosæ are built up; a mere jelly-like ball with two long tentacles, one placed on each side. Such an animal, having legs instead of tentacles, a distinct ganglion in the centre, hæmal and digestive processes forms the typical "somite." A number of these somites joined together forms an annulose animal, and the junction of three or more rings into a head or thorax determines the difference of Insect, Arachnid, or Ecrustacean. An annulose animal is therefore a continued multiple of two, and even those organs which are apparently simple are really dual. Thus the butterfly's trunk is composed of two pieces—the bee's sting has a double, or symmetrical sheath. The Vertebrata may probably be looked upon as two annulose structures arranged longitudinally; the one represented by the brain and spinal column, the other by the ventral portion of the body with the digestive, hænal, and sympathetic nervous processes—but whether this be so or not, the dual character is distinct throughout. We have two ears, two eyes, two nostrils; our brain, our heart, our dental arrangements are double, and though this paper is not intended to deal with metaphysical questions, few will doubt that in the presence of an involuntary muscular action contrasted with a potent volition, in the combination of a mind that deals with the conditions of existence interwoven with as it were another mind capable of abstract thought and creative imagination, we have a duality corresponding with that of the body. In the vegetable kingdom, also duality is well represented. Besides the sexual distinction to which I have already alluded, we have the fact that ovules are universally produced in pairs. The typical carpel is, in fact, a pod with two seeds. Sometimes, as in the filbert, one seed gorges himself to gigantic dimensions at the expense of his poorer brother, who dwindles to a husk; sometimes, as in the chickweed, the two seeds become as many score; but the unripe ovary always tells the same tale of double birth. The growth of minerals is more obscure, but recent researches have thrown much light upon the modes in which minerals crystallize or congeal. Throughout these investigations great stress is laid upon the law of *polarity*. To the eye of the modern philosopher every particle is but a little magnetic needle, having its poles of attraction and repulsion; and this polarity has been claimed by Tyndal not only for the particles composing the crystalline structure of minerals, but even for those of the human brain itself. I have good authority therefore for saying that even minerals are dual.

Number Three comes next; the type number of all that great division of plants known as the Endogens, or Monocotyledons. These plants, comprising every variety of vegetable production, from the tiny grass to the gigantic cocoa-nut palm, from the coarse bulrush to the delicate lily of the valley, differing in all else, unite in this peculiarity that their leaves, under all their modifications, occur in whorls of three. The flowers have a calyx of three sepals, a corolla of three petals, one or two sets of three stamens, and an ovary composed of three carpels with a trifid stigma. In many of the sedges this character is extended to the stems, which are triangular. In few of Nature's groupings does she show more regularity than in this, yet here we find an exception utterly unexpected and incomprehensible. In the large families of the grasses, sedges, and rushes, the carpels are generally two, and those so well developed and so regular in their size as not to admit of the supposition of a suppression of parts, while on the other hand ovaries of three carpels are often found among the Dicotyledonous plants combined with flowers whose other parts do not follow the same arrangement. Besides this striking occurrence of Number Three we find instances of it in unexpected places, as in the presence of trifid hairs or trichotomous cymes, and doubtless each instance is replete with instruction could we but trace it. In the Animal Kingdom three is not a common number, and when met with is always associated with something strange or exceptional. Such an instance is the easel-like form of many Crustaceans in their first stage, which is remarkable not only from its utter dissimilarity to any form of the animal, but also from its trenching, as it were, on the province of mechanics, presenting us with that form of structure, a hollow pyramid, which has always been held the most stable of all, in a swimming animal, who has no need of stability. Again, many of our insects have three eyes, or *ocelli*, placed in the form of a triangle, on their foreheads. We can scarcely realise the necessity for these organs, the insects who bear them being provided with compound eyes constructed to cover the whole field of possible vision. If we suppose, as has been suggested, that the so-called compound eyes are not actually organs of sight, we are left in the hopeless difficulty of assigning another use for them, If we look upon the *ocelli* as merely a reduced copy of the Arachnid type, our perplexities increase. The spider's eyes, whether two, six, or eight, are arranged in pairs, and the suppression of single eyes could not possibly make an equilateral triangle. The *ocelli* remain a unique and unmistakeable distinction of the insect tribe. In the Mineral Kingdom we find occasional trihedral prisms and pyramids, but we rather associate the Number Three with the axes by reference to which crystalline forms are classified. Artificial as this arrangement may seem, it is open to question whether the natural formation of a crystal is not very similar, and at any rate it is impossible to group solid forms without a geometry of three dimensions—length, breadth, and thickness.

The Number Four is a very important one in Nature. Amongst animals it suggests the vertebrata. That large class, differing so entirely from all other animals in their bodily and (shall we say) mental characteristics, are universally distinguished by four limbs, expressed or understood, as Euclid says. In the Land Mammalia, and the lizards, this fact is readily recognised, but becomes somewhat obscure when we find them changed into wings in the birds, flappers in the turtle, and fins in the fish, or suppressed altogether as in most snakes. Still a consecutive observation of vertebrate skeletons will convince the student tha the vertebrata are essentially four-limbed animals. Bacon's observation on snakes comes in well here. It is true that the gliding snake does form its flexible body into four curves, and at the alternate junctions of these curves, just, in fact, where our instinctive habit would place the shoulders and loins, there are two strong positions which take hold of the ground with more force than any other part. If a long snake be wounded by a blow from a cane, it is from one of these places that he raises himself, and if he be held in front of a scorching fire these two points of his body at once project themselves, giving rise to the widespread belief of bushmen and savages, that snakes have short legs beneath their skin. This number seems nearly peculiar to the vertebrata, as I find only one other instance of it, namely, in the Medusæ, or jelly fish. These beautiful organisms are marked with four radiating canals, which were long looked upon as a mark of distinction between the Discophora, or naked-eyed Medusæ, and the gonophores of the Campanularida. It is however found in both, and in the "hidden eyed" Medusæ, the cruciform mark is also very evident. The Number Four is no less important in the Vegetable Kingdom, where it furnishes a type for the two widely differing orders, Labiatæ and Cruciferæ. In the former the arrangement is fairly uniform. The stem is square, the stamens are four, and very often the antlers are divided into lobes so as to form a double cross; the carpels contain four seeds, which arrange themselves into a perfect square. Yet the corolla and calyx are each divided into five lobes. In the Cruciferæ there are four sepals, four petals, four nectaries, and four stamens of equal length, but the stems are not square, the carpels are but two and there is an additional pair of long stamens; nevertheless the fourfold character is the most evident mark of these two orders, as also of the Herb Paris, the Galium Cruciatum, and a few other plants. The mineral world has no fours, the few tetrahedrons and squares being referable to the triangular shape.

Five is a number that plays a singular part in Nature. It is the leaf number of almost all our best known plants and trees. Most of the Dicotyledonous flowers have five divisions to their calyx and corolla, their ovaries are mostly formed of five carpels, and their stamens are some multiple of five. Generally, too, their leaves are arranged in a spiral in which every fifth leaf comes on the same perpendicular line. There is no number more common in our higher plants than this; and curiously enough, it seems to overleap the boundary and fasten on those animals which are always considered nearest of kin to the vegetable world. The Zoanthariac Actinozoa always have their tentacula in multiples of five, the Dicotyledonous number, or three, the Monocotyledonous number. Our common anemones display on their bases a radiated structure, in which five conspicuous marks may be observed. The little fresh-water hydra spreads five tiny tentacles to catch his prey; the star-fish has five arms or ten, the double of five. The sea urchin is covered with five sided plates, arranged in five double zones, radiating from a mouth furnished with five teeth, which crown a curious five-sided structure called the "lantern." The Holothuria, and other kindred organisms, repeat, with less accuracy, this division into five radial zones. The number five disappears in the Radiata, to reappear in the vertebrata. With all the various arrangements for swimming, running, and climbing, the number of claws on a bird's foot varies considerably, and four is a more common number than five, which, in fact, is only found in domesticated varieties, but there can be no question as to five being the type number of fingers and toes in the mammilea. In many cases, as in the Hoofed Animals, several are wanting, but the number is never exceeded, and may be looked upon as constant. Number Six is common enough, but is generally a mere double of three. It is, however, noticeable as being the sign of that hexagonal form which is found in the honeycomb, the cellular tissue of some plants, the crystals of snow, &c. It is fashionable to account for this form by the mutual pressure of circles, but it is in many cases deliberately chosen by animals who build under circumstances where external pressure is impossible. The Number Six is also remarkable as being that of an insect's legs, and when we consider the great difference between the animals forming their class, we are astonished to find them connected by so uniform a link, and the more so when we remember that only four wings accompany them, the number being made good in the Diptera by the presence of "poisers." Seven is remarkable as being the constant number of cervical vertebræ in the Mammalia, the two exceptions being only apparent. When we compare the short neck of the whale with the long one of the giraffe, and reflect that each is composed of the same number of bones, we feel that Nature has gone apparently out of her way to preserve what seems to us an unimportant point of likeness between animals differing in in almost those points which we should consider essential. Eight and Ten are numbers representing the limbs of the Arachnida and Crustacea respectively, and they are suggestive. In the Centipede, composed of a large mumber of *somites*, each with its two legs, its hæmal and digestive apparatus, and its central ganglion, we have a mere line of connected parts, following a head, which, as composed of several rings, indicates a centralization of vital power.

In the far superior Crustacea, five rings only support a massive head, and the remaining rings only become a mere tail. In the Arachnida the rings carrying legs are diminished to four, and in the insects to three, each time with an increase of vitality, and a higher organization. The next step would take us to a far superior animal, having only two rings, or four limbs, the remaining rings being diminished to a tail—to the vertebrates in short.

The higher prime numbers are not altogether unrepresented in Nature. Thirteen is the type number of dorsal vertebræ in the Mammalia. Twenty-two gives its name to a lady-bird having that number of spots; but these are mere curiosities. The facts I have mentioned are not so. The constancy of fives and threes in flowering plants, of the former number in Hydrozoa, of fours in the vertebrate animals, and of twos throughout, point to laws of which we know nothing. So long as Nature indicates and emphasises these laws, and so long as we are ignorant of them, such a paper as mine is not, I submit, out of place in a Society devoted to the study of Nature in all her phases.

On the conclusion of the paper, the **CHAIRMAN** briefly thanked Mr. Lomax, and a conversation ensued, in which several of the Members took part.

THE DEATH OF MR. T. B. HORNE.

Mr T. W. **WONFOR** (the Secretary) said he had an announcement to make of a rather painful character, death, which had been busy in their ranks, having removed one of their four fathers. He used the expression, four fathers, because the four gentlemen whose photographs appeared in the Society's album were really the founders of the Society. Dr. King, Dr. Turrell, Mr. Arthur Wallis, and Mr. T. B. Horne, were returning to Brighton in a fly, in 1853, from a conversazione at Lewes, when the idea of this Society was mooted. The conversation which took place on the subject resulted in the holding of a meeting, at which Dr. King presided, and this meeting was the origin of the present Society. Mr. Horne was one of the Secretaries; the other leaving after a few months, he (Mr. Wonfor) was brought into practical connection with the Society. When Mr. Horne resigned his position, he was succeeded by Mr. Onions, but Mr. Horne continued his connection with the Society as Treasurer. Subsequently he left Brighton and went to reside at Torquay. But the Society, loath to lose him, pressed him still to continue as Treasurer. This post he after a time resigned and was then by special vote of the Society elected a Vice-President, an office he continued to hold until his death, on the Sunday or Monday previous. All who knew him, knew him as a genial, kind-hearted man, who wherever he went gathered around him a number of friends. He had a large number of friends in Brighton; and in Torquay he had also left, as in Brighton, a great gap. He (Mr. Wonfor) felt strongly his loss, because Mr. Horne had been a great friend to him in his early residence in Brighton, and gave him a good deal of advice and comfort. At starting the Society had very humble ideas —simply of taking in a few periodicals, meeting occasionally, reading papers, and having discussions. The meetings were then held at the Dispensary; and he might mention as an instance of their lowly aims that one paper was read at two successive meetings, the President, who was absent on the first occasion, wishing to hear it read. Such a circumstance he believed had never occurred before in connection with any other Society. Since that time they had grown considerably, and had now about five times the number of Members; though he wished some of them would show the same amount of energy as the originators of the Society.

November 23rd.

MICROSCOPICAL MEETING.

Mr. G. D. Sawyer (the President), Mr. J. E. Haselwood, Mr. T. Glaisyer (the Treasurer), and Mr. R. Gliasyer (the

Librarian) exhibited interesting objects under microscopes. Among those shown by the President were spinnerets of the spider, effectively seen with the spot lens, and peristomes of funaria exhibited by Mr. Haselwood. Crystals from vapour of coke were likewise shewn with the polariscope by the President. The President also reminded the Members that, on Wednesday next, the annual soirée of the Croydon Microscopical Club would be held, to which they were invited; and that the December Microscopical meeting, falling in Christmas week, would not take place.

DECEMBER 14TH, 1876.

ORDINARY MEETING.

Mr. **SAWYER** exhibited an interesting specimen brought by him from the petrifying spring near the sub-Wealden boring at Netherfield, Battle, which was visited by the Society at their 1874 annual excursion. The specimen gave an excellent idea of the action of the spring, being an irregular mass of stalactitic shape. He also showed specimens of stone from the Nightingale Valley, Bristol, one of which was plainly composed of minute shells, the other showing the presence of zoophytes.

Mr. C. E. **CLAYTON** showed a tooth of *elephas primogenus*, dredged up 15 miles off Beachy Head, and thickly incrusted by marine deposit. Mr. Clayton suggested, in default of the theory that the specimen had been washed from the elephant bed at Kemp Town, whether a similar bed might not exist where the specimen was found? Mr. Clayton also produced what appeared to be an axe-head of very ancient date, found in the course of some drainage excavations in Montpelier Place. It was formed nearly wholly of copper.

Mr. W. **SAUNDERS** handed round for inspection a portion of a siliceous sponge known as the blanket sponge, from its flattened shape and peculiar texture. It was found off the coast of Portugal, at the great depth of 500 fathoms, being attached to the 1851 electric cable.

Mr. W. C. **Wallis** showed some polished boulders from the boulder clay on the Durham coast, upon which appeared scratches caused by glacial action; and also a number of small bones (unsorted) found in the glacial drift in the neighbourhood of Sunderland.

Other minor specimens were exhibited by different Members.

January 12th. 1877.

ORDINARY MEETING.—MR. PANKHURST ON SOLAR PHYSICS, WITH ILLUSTRATIONS BY MEANS OF THE LIME LIGHT.

"Are not," said Newton in his eleventh Query, "the sun and fixed stars great earths vehemently hot, whose heat is conserved by the greatness of the bodies, and the mutual action and reaction between them and the light which they emit; and whose parts are kept from fuming away, not only by their fixity, but also by the vast weight and density of the atmospheres incumbent upon them, and very strongly compressing them and condensing the vapours and exhalations which arise from them?" What answer or answers does science enable us to give to this query at this time—nearly 200 years after Newton wrote it, and what are the principal facts and observations on which our knowledge of the sun is based? The task which I have imposed on myself to-night is to give you a short *resumé* ot the means by which we have attained to an acquaintance with the nature of the sun's constitution which Newton's imagination, great as it was, can scarcely have prefigured. I need, perhaps, scarcely remark that the great ruler of our planetary system, the fountain head of its life and light, is a huge globe, nearly ninety-two millions of miles from us, eight hundred and fifty thousand miles in diameter, and that its volume is one million two-hundred thousand times that of our globe. It outweighs, too, 750 times the planets which circle round it, and its volume with regard to them is represented to you by the diagram on the screen.

Soon after the discovery of the telescope, Fabricius noticed by its aid a black spot on the sun, which he took at first to be a terrestial cloud. "My father and I," he says, "passed the rest of the day and the whole of the night in great impatience, trying to think what this spot might be. But the next day it was still there. One disappeared, but ten days after it reappeared—it had gone round the sun." Galileo also directed his "optick tube" to the sun; and observing carefully the time when a spot disappeared and when it reappeared, determined thereby the great fact that the sun revolves on its axis. The period of rotation he determined to be 26 days. Upon the screen is now a beautiful photograph of the sun's disc taken on September 20, 1870, by Mr. Warren de la Rue.

To the early astronomers the nature of a sun spot was a problem which their small telescopes and poor appliances could not solve. They were thought to be planets passing over the sun's disc; vast masses of scoriæ emitted by the solar volcanoes, &c. It was not, however, until 1774 that Dr. Wilson, of Glasgow, demonstrated that the spots were cavities in a luminous envelope. surrounding the sun, which according to him was a dark globe The appearance which a sun spot presents as it passes round the limb of the sun, as seen through a large telescope, is now represented on the screen. First, then, we have determined that they are cavities in the luminous matter of which the surface of the sun is mainly composed. Cavities! yes, but of what size? In 1769 one was visible to the naked eye. Consider what the size of this must have been when we learn that the smallest spot observable by a large telescope must be at least as big as Scotland. In August, 1859, a spot was measured by Newall, which had a diameter of 58,000 miles, that is, seven times the diameter of the earth. In June, 1843, a spot was visible nearly 75,000 miles in diameter. In March, 1858, during an eclipse, the moon passed over one 107,000 miles across, and in the same year the largest spot of any on record was visible. It had a breadth of no less than 143,000 miles! Across it 18 globes as large as our earth might have been placed, and a hundred worlds as large as ours hurled into the abyss, and yet it would not have been filled to the brim. The photograph now thrown on the scene is a copy of Nasmyth's drawing of this vast abyss in the luminous envelope of the sun. This light-giving general surface of the sun is termed the photosphere; and before we can rightly understand the nature of a sun spot we must know something more of this luminous envelope. I do not speak, remember, of the body of the sun itself, for of that we know very little, if anything. All that we know about is the outer coating—the rind, so to speak, of the great orange, its photosphere and atmosphere. You will observe, then, first of all, that the suns surface is ragged, uneven, coarsely mottled with patches of varying brightness.

In the representation of a sun spot now on the screen (after Nasmyth's drawing) these smaller patches of light assume somewhat the form of willow leaves. This was the name given them by Nasmyth. Other astronomers have designated them by the words, rice-grains, straws, granules; and others, failing to see any likeness to these, have fallen back on the charmingly indefinite name of "things." Remember, however, that the smallest of these rice grains must be at least as large as Great Britain. You will get perhaps a better idea of the general surface of the sun from this copy of a drawing, by Secchi, which is now before you. Here also you will see how these willow leaves link themselves together and shoot out a huge bridge of light, spanning the vast abyss, on the edge of which they are so well defined. And now I think it will be clearer to you what sun spots are. It is not, however, quite enough to say that they are cavities in this liquid, or more probably densely gaseous photosphere. There are still one or two other points in which they demand attention. They generally exhibit three shades of darkness; the darkness increasing from the general surface till the apparent centre of the spot is reached. We have first the penumbra, then the umbra, then the nucleus. Again, these spots are for ever changing their form. The photograph now on the screen will give you an idea of the

extraordinary changes which a larg
the course of a few days. It is a re
them that they are scarcely ever o
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Remembering the vast size of th
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When the sun-spot period was published, Sabine found the years of maximum and minimum to correspond almost exactly with the years of maximum and minimum intensity in the magnetic storms of the earth. Again, Mr. Meldrum of the Mauritius has been for years tabulating from the logs of passing vessels the cyclones of the Indian ocean. He has found after tabulating these storms for years that they also are subject to periods of maximum and minimum, and these correspond with singular exactness to the sun-spot period. The rainfall at Brisbane and Port Louis and other places has also been shewn to vary with these sun storms. And I know not how far diseases, blights, famine, and pestilence; periods of abundance, of wealth, of poverty, and of depression may not be found in the future to be ultimately associated with the changes which sweep over the surface of the sun. Let me now call your attention to what are termed the faculæ.

In the copy of the beautiful photograph of the sun's limb, taken by Mr. Warren de la Rue, which is now on the screen, you will observe heaped up masses of light round the spot. These more brilliant portions of the sun's surface are what are termed faculæ. They may be of all magnitudes, from softly gleaming narrow tracts 1,000 miles long, to continuous complicated and heapy ridges 40,000 miles and more in length, and 1,000 to 4,000 miles broad. "The sun's surface we have learnt is of a cloudy nature, the light and heat being derived from the solid incandescent particles of which the clouds are composed. For there are changes continually going on between the cooler exterior and the interior. The descending current is accompanied by a spot, the ascending one by a facula." Now, as I have shewn you how far reaching is the influence of the spots of the sun, so I will give you an instance of how far the appearance of a brighter portion may thrill through the universe. Mr. Carrington, whose observatory was near Redhill, writes, "I had secured diagrams of all the groups and detached spots, and was engaged at the time in counting from a chronometer and recording the contact of the spots with the cross wires, when within the area of the great north group two patches of intensely bright and white light broke out in the middle of the group. I hastily ran to call some one to witness the exhibition with me, and on returning, within 60 seconds, was mortified to find that it was already much changed and enfeebled. In the interval of five minutes the two spots traversed a space of 35,000 miles. Mr. Hodgson, at the same moment, happened to be watching the sun, and saw the dazzling·brilliancy of this outburst of light on the sun. The magnetic needles at Kew Observatory, it was afterwards ascertained, at that instant oscillated violently. " By degrees," says Sir J. Herschel, "accounts began to pour in of great Auroras seen on the nights of those days, not only in these localities, but at Rome, in the West Indies, and the Tropics, where they hardly ever appear." At Melbourne, on the night of September the 2nd, the greatest Aurora ever seen made its appearance. These Auroras were accompanied with the electro magnetic disturbances in every part of the world. In many places the telegraph wires struck work, had too many private messages of their own to carry. At Washington, the telegraph men received severe electric shocks. At a station in Norway, the telegraph apparatus was set fire to, and at Boston a flame of fire followed the pen of the instrument.

In 1773, Vassemus, during a total solar eclipse, saw red clouds floating, as he supposed, in our atmosphere. It was, however, during the great eclipse of 1842, which Airy, Arago, Baily, Struve, and others watched with careful scrutiny, that all of them saw with surprise rose-coloured prominences round the disc of the eclipsed sun. They were described as protuberances resembling mountains, bloodcoloured streaks of light, masses of rich carmine vividly bright, slender tongues of fire visible five minutes after the re-appearance of the sun. On the screen is the copy of the photograph taken of the eclipsed sun as seen on December 22nd, 1870. Now, what are these masses of crimson fire, rising sometimes to a height of 80,000 miles from the edge of the sun's disc, surging up in countless numbers from the glowing matter which surrounds him? They are up-rushes of the luminous white-hot matter of the photosphere, cooled in the space in which they are projected from a white heat to a red one.

The spectroscope has determined for us their constitution; they are almost wholly incandescent hydrogen gas. No grander example of their magnitude and splendour has been seen, perhaps, than the one which Major Tennant succeeded in photographing. We will now throw on the screen a copy of the picture he took. You see there that enormous column of flame which rises to a height of 80,000 miles. But the structure of it is also very remarkable. Before you is now a representation of it on a larger scale, and the spiral form of it bears witness to the direction of the enormous force which hurled it upwards into the space. You will remember also the spiral cyclonic form which has been noticed in the sun-spots. But the forms of these fiery clouds are manifold. They are for ever changing. They have the tongue-like motion of a flame swaying backwards and forwards as at a great conflagration. Jets rising up as from a fountain, and bending back again to the sun as in those drawings of them now before you. Again they transform themselves into semblances of trees and bushes, and into shapes as fantastical as the widest fancy can imagine. Of the thousands which Respighi has mapped and figured, I will but shew you a few as an example of these singular forms. This portion of the sun's atmosphere has been termed from the colour which it displays the chromosphere. This we are prevented from seeing except in eclipses, by reason of the strong light emitted by the sun. But the sun's atmosphere does not end here. The strange and beautiful light of luminous gas extending far into space and taking sometimes a strange configuration had been noticed surrounding the eclipsed sun. This more rarified portion of the sun's atmosphere has been termed the Corona.

The five views of the eclipsed sun now on the screen are from drawings taken in 1851. We can get from them little idea of the beauty of that brilliant clear halo of white light surrounding the dark edge of the moon which observers of eclipses are privileged to see. In the next view of the eclipse of 1870, you will see the rosy prominences of the chromosphere standing out against the luminous corona. As seen by Gillman, in 1869, it is described as an infinitude of fine violet, mauve-coloured, white, and yellowish-white rays issuing from behind the moon. A copy of Gillman's drawing is now before you and you may, from it, perhaps form some idea of the splendour of the spectacle. Lastly, I cannot altogether quit the subject without speaking for a few moments of the marvellous results of Spectrum Analysis in its application to Astronomy.

Newton's speculation as to the sun being a vehemently hot earth has been so far confirmed that we know that iron, nickel, manganese, magnesium, cobalt, chromium, sodium, titanium, and calcium are present in the vapours of the sun. I will just throw on the screen the spectrum produced by sunlight, wherein you may see the well-known dark lines which, first recognised by Fraunhofer, yielded their secrets to Stokes, Bunsen, and Kirchhoff. So far, we have not discovered in the sun itself any body not known as a constituent of the earth. But in the spectrum of the Aurora, there is a peculiar green light, which is almost the only light given by the great majority of them, and these coincide precisely with the three lines observed in the spectrum of the sun's corona.

Now, as Professor Tait remarks ("Recent Advances in Physical Science," p. 151), it is a very singular fact that the terrestrial substance which gives these lines has not yet been discovered, and the coincidence of them with the three Aurora lines seems to promise us wonderful information as to the similarity of the upper regions of the earth's atmosphere. In fact, the whole tendency of modern science is to show us how delicately balanced are the forces, how wonderfully organised the matter which together constitute the great universe of which we form a part. The study of the sun has taught us how a vortex in its luminous sphere, or a flash of light upon it, may thrill through the whole framework of this world of ours, affect the fabric of human society, and its last waves ebb away, as it were, in human hopes and fears. It tells us how planets react on the sun, round which they circle, and thus must in no slight degree cause their influence to be felt on every member of the system to which they belong. We learn from it (greatest wonder of all) that the beam of light issuing from worlds, whose distance is unimaginable, contains within itself marvellous records of its source; indications of a history in the past too grand almost for us to comprehend, and intimations of a future which seem to us like a prophecy.

The PRESIDENT (Mr. G. D. Sawyer) proposed a vote of thanks to Mr. Pankhurst.

Dr. Corfe, was pleased to find that Brighton possessed a gentleman who made the question of solar chemistry his study. Of course, their friend had only touched lightly upon spectrum analysis. There was no question but that solar, lunar, and planetary light were the same, but stellar light was independent, and the same spectrum was not found in it as in solar. These were important facts bearing upon the physiology of human nature, though many disbelieved it. Speaking with regard to lunar blindness, he said when a man slept in the tropics in the moon-beams he frequently became moon-blind. There was also a singular fact about the yellow colour of the sun. They were aware that the yellow colour predominated in the tropics of the sun, and as a curious coincidence we had the predominance of yellow flowers in our own tropics; and it was a remarkable fact also in chemistry that the yellow fixed the resin in trees, and they had the gum resin of the tropics as a proof, whilst the acacias, or minor gums came from the sub-tropics. The gums in the tropics were an excessive concentration of hydro-carbon. These were all interestings facts connected with the physiology of their system.

Mr. J. Haslewood said Mr. Pankhust had spoken of the stability of the solar system, but his little reading in the matter led him somewhat to the contrary opinion. There might be stability in a certain sense, but there was an everlasting change going on. For instance, some few years ago a star of the twelfth magnitude suddenly and very rapidly rose to a star of the third magnitude. If there were any planets there they must have had a fine time of it. There was another remarkable physical phenomenon that came from across the Atlantic some months ago. The question there was "Are we drying up?" Our recent experience here was somewhat to the contrary. A writer there said their vapour was gradually passing away, and that some day they would be high and dry, and they would have no sea or water of any kind. He should like to have a whole evening devoted to the spectrum analysis, as he was sure it was a subject to be made very interesting and instructive.

Mr. B. Phillips said Mr. Pankhurst had shown them in his interesting paper that the spots on the sun were in all probability cavities, in its chromosphere and photosphere. But he omitted to state what seemed to him a most conclusive proof that they were cavities, for it was said by unbelievers that when the cavity reached the edge of the sun they ought to see a dent, but they never saw anything of the sort. That was a difficulty never removed until the great solar eclipse observed in the north of Spain, on which occasion photographs were taken, and a dent was distinctly visible. The great protruberances mentioned by Mr. Pankhurst were visible not only during an eclipse, but at all times, and he should like to ask him about that. Speaking with regard to the corona, he said it was his opinion that it was probably due to the action of the sun's light upon our own atmosphere, and not entirely due to the sun.

JANUARY 21ST.

MICROSCOPICAL MEETING.

The PRESIDENT (Mr. G. D. Sawyer) mentioned among other matters, that Mr. Curties, of Holborn, had forwarded to the Society's cabinet two slides, viz., the Spiculæ of *Gorgonia* and of *Gorgonia massibulata.* These were afterwards exhibited under the President's microscope under the spot lens, and excited much admiration, not only on account of the natural beauty of the objects, but also from their peculiar arrangement, they being so arranged in the mounting that the united spiculæ presented the appearance of small sprigs or trees.

Dr. Hallifax then introduced some remarkable specimens of a curiously cup-shaped fungus. In colour, they were bright scarlet and gained a heightened beauty from the delicate green mosses by which they were surrounded on the portions of the tree branches to which they were attached. Considerable discussion ensued as to whether these peculiar growths should be classed as fungi or lichens, as, under microscopical examination, Dr. Hallifax could not identify their characteristics with those of true lichens. The specimens were handed to him by Mr. J. T. Whatford, who received them from a friend residing near Abingdon in Yorkshire, in which neighbourhood they had been obtained, so that he had no previous history to guide him in their classification.

Mr. Haselwood pointed out that they were specimens of the *Pezizæ*, a large group of fungi.

The meeting then became a conversazione, when the President exhibited, among many other interesting objects, a series of crystals, including those of bi-chromate of potash, oxalic acid, nitrate of ammonia, Epsom salts, and sulphate of zinc, which were shown to great advantage with the polariscope, as were also some finely-mounted scales of fishes.

Dr. Hallifax exhibited a slide mounted by Mr. d'Alquen, containing a few hairs from the seed vessels of the common wild rose, and pointed out their evidently tubular structure and peculiarly curved general outline.

Mr. Haselwood also exhibited some beautifully-mounted slides, amongst which were especially admired a preparation of the skin of the dogfish, peristomes of Funaria, &c.

A cordial vote of thanks was also passed to Mr. Curties for his presentation of slides to the Society's microscopical cabinet.

FEBRUARY 8th.

ORDINARY MEETING. — MISS AGNES CRANE ON CERTAIN GENERA OF LIVING FISH AND THEIR FOSSIL AFFINITIES.*

Mr. T. W. Wonfor, one of the Honorary Secretaries, then read Miss Crane's paper, which was illustrated with tables of classification and distribution, and with several diagrams, for the rough execution of which an apology was offered.

On first thoughts, it may seem that the lowest group of vertebrates, of all the divisions comprised in the animal kingdom, might be most easily described, and its zoological limits defined; but, on examination, the fishes prove to be most curiously linked to the invertebrata below and the amphibian reptiles above. In fact, it is not easy to draw the lines positively between them, and to say where the true vertebrates begin, or where the piscine characters are merged in the reptilian.

It is proposed to refer to-night to some of the most aberrant forms of living fish and their fossil affinities; then, briefly passing in review the distribution of the various families in geological time, to see how far descent with modification is traceable in this class of vertebrates.

THE LOWEST VERTEBRATE.

It is well known that the lowest vertebrate form is the anomalous lancelet (*Amphioxus lanceolatus*), which is found burrowing in sand banks on our southern shores and in the Mediterranean. The position which this singular species should occupy in the animal kingdom has long been a subject of debate among naturalists. Some, like Agassiz, separate it entirely from all other fishes, while Haeckel proposes to place it in a distinct division of the *Vertebrata*, and Professor Semper removes it from the vertebrates altogether. But Professors Owen[*] and Huxley[†], considering it to possess the rudiments of a skull and brain, with the elements of a vertebral column, retain it among the fishes, and it forms the first or lowest orders of their respective systematic arrangements.

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* The writer is much indebted to Dr. Günther, F.R.S., and Mr. Davies, F.G.S., of the British Museum, for information kindly imparted, and facilities and assistance afforded in the examination of specimens.

In *Amphioxus*, which ranges from one and a half to two inches in length, the vertebral column is notochordal throughout life, that is to say, composed of a membraneous rod enclosed in cartilage, and as there is no enlargement of the skull for the reception of the brain, the animal tapers nearly equally at either end. The skin is scaleless, lubricous, and so transparent that the internal structure is visible, and the eyes are not more fully developed than in the common leech. The mouth is vertical, jawless, and suctorial, and is furnished with vibratile cilia. The lancelet possesses neither heart nor swimming bladder, and is without ribs and even rudimentary limbs. In all other fishes respiration is effected by means of water passing through the mouth and escaping by the gills, or their equivalents; in this species it traverses the whole interior of the animal and escapes by a special pore on the under surface of the body.

[‡] Professor Goodsir, long ago, called attention to this peculiar mode of respiration, and noticed the resemblance between the enlarged phrangeal sac of Amphioxus and that of the tunicated mollusks or sea-squirts. He considered the lancelet also as allied to the annulosa, from the simple organization of its respiratory and circulatory system, and M. Kowaleves'ky has more recently traced a close affinity between this species and the early stages of some Ascidians. Thus, in *Amphioxus* are united

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[*] Anatomy of Vertebrates. Vol i.

[†] Preliminary Note on the Structure of the Skull and Brain in *Amphioxus lanceolatus*. Proceedings of the Royal Society, 1874. No. 157. December.

[‡] Transactions of the Royal Society of Edinburgh. Vol. xv., pl. 11, p. 259.

characters belonging to the *Tunicates* and *Annelides*, and unexpected relations are revealed between the *Vertebrata* and the *Invertebrata.*

THE MOST HIGHLY ORGANISED FISH.

In the *Lepidosiren*, the highest of all the fishes, we find an organization of a no less complex nature. The genus was founded in 1837 by Dr. Natterer for the reception of a singular animal to which he gave the specific name of *paradoxa*, discovered by him in America, inhabiting the swamps in the vicinity of the river Amazon. This species, which attains a length of three feet, the body being eleven times as long as the head, * is now becoming very rare. In 1839, Professor Owen referred specimens from the river Gambia of West Africa to the same genus, under the designation of *Lepidosiren annectens*, and classed them in a provisional group between the reptiles and fishes. They are placed by Professor Huxley in the highest order of his classification of fish, namely, the *Dipnoi* or "double breathers," and are popularly known as the mud fishes.

These paradoxical "scaled sirens" have well developed reptilian lungs co-existing with functional internal branchiæ, and are capable of living either in the water or out of it. Their structure and habits are very peculiar. During the rainy season, the waters of the Gambia overflow its banks, and the mud fish is carried out of the true bed of the river. When the waters retire it is left stranded ; then, burrowing in the softened mud, it coils itself up, keeps open a communication with the air above its nest, and breathes by means of its modified swimming bladder. It thus remains inactive till the return of the floods soften the walls of its cell, when it emerges, and resumes its former habits. They have been found in a semi-torpid state eighteen inches below the surface, in situations were the ground is dry and hard for months in the year, and are dug out by the natives with a sharp pointed stick and used for food.

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* Transactions of the Linnean Society. Vol. xviii.

A specimen of *L. annectens* has been on exhibition in the entrance hall of the Brighton Aquarium for more than two years. It is kept at a regular temperature of 70 degrees, and is in a very thriving condition, having grown several inches since it has been in the institution, and thickened proportionately. The animal generally lies quietly at the bottom of its tank, rising occasionally to the surface to take in air. It is fed three times weekly on small pieces of raw beef, which it can be observed to eat in a very unusual manner. When the food is thrown in, the mud fish stretches itself leisurely and seizes it, as it comes within reach, between its sharply formed vomerine teeth. After masticating it slowly, it throws it out with a quick jerk and, commencing at the other end, repeats the manœuvre; it then again rejects it and subjects it to a third process of mastication before finally swallowing it. The body of the *Lepidosiren* is fish-like, and covered with small cycloid scales, simply constructed pectoral and ventral limbs are present, with a dorso-caudal fin. The notochord is persistent, but the skull is partly bony, partly cartilaginous, and the costal arches and neural and hæmal spines are well ossified; thus it forms a link between the bony and cartilaginous types of fishes. The dentition is composed of a pair of vomerine teeth, and two molars in each jaw. The heart is three chambered, and true lungs exist with rudimentary external branchiæ and functional internal ones.

LIVING AFFINITIES OF LEPIDOSIREN.

Among living fish, the *Lepidosiren* is most closely related to another "dipnoid," discovered in the rivers of Queensland, Australia, in 1870. This species was at once, with singular accuracy, referred by Mr. Gerard Krefft, the late curator of the Sidney Museum, to *Ceratodus*, a genus till then only known by the fossil teeth occurring abundantly in Triassic and rarely in "Oolitic" strata. He also described it "as a gigantic amphibian, and as allied to *Lepidosiren*," the correctness of which determination has been fully demonstrated by the subsequent minute investigations

of Dr. Günther* and Professor
exhaustive memoirs on this subje

Two species of living Cerato
after its discoverer, the Hon. Wi
and *Ceratodus miolepis*, distinguish
ornate scales. These fish, known
the fresh and brackish waters of t
night leave the streams, and go ou
and rushes, subject to tidal influe
of opinion that they do not proba
limbs are too flexible and feeble to
considers that though they may be
the water, they could not remain lon
it. The species, which range up to
pounds in weight, appear to feed e
plants, *Myrtaceæ* and *Gramineæ*, take

The body of *Ceratodus* is cover
and the limbs are structurally identi
but the axis and fringe are more
distinctly visible. The internal skel
aginous type, resembles that of the
partly osseous. The anterior nasal
the lip, in front of the vomerine tee
are placed in the cavity of the mouth
ones. The dentition is essentially
modified to suit herbivorous diet, bein
and crushing" instead of "piercing
a pair of vomerine teeth, and two mol
the correctness of the views of Pan
assigned that number of dental date
middle geologic ages. The respirator
Lepidosiren, but the gills are more de

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[*] Transactions of the Royal Society 1871.

[†] Proceedings Zoological Society, 1876, P
Mantell Coll. British Museum, June.

when inhabiting clear waters the fish probably breathes by them alone, the true lungs only coming into action when on the mud flats, or living in turbid waters. The shape of the body, the number, position, and structure of the fins, the elements of the internal skeleton, and above all the co-existence of a lung with gills, show how close is the affinity between the Australian *Ceratodus* and the mud fishes of Africa and South America, and although the former approach less to the amphibian type than the latter, it is obvious that in a natural classification their place is side by side.

FOSSIL AFFINITIES OF THE DIPNOI.

Having shown the close connection between the two genera of living dipnoids, let us now consider the relations of the living and fossil Ceratodonts. No remains of this genus have as yet been found in the Tertiary or Cretaceous formations, but the fossil teeth, of which several varieties are recognisable, possibly the relics of numerous species, occur abundantly in the Triassic beds of Aust Cliff, near Bristol, and in the Muschelkalk of Germany. They have also been obtained from strata now determined to be of Triassic age at Maledi, South of Nagpur, in India, and associated, as in Europe, with the reptilian remains *Hyperodapedon.*

Many of these fossil teeth are much larger than those of the existing species (specimens of one Triassic form measure over two inches in length), and must necessarily have belonged to individuals of a gigantic race. The dental plates only have been found fossil, but the structure of *Ceratodus Fosteri* indicates that they alone of a like constructed animal would be susceptible of preservation in sedimentary strata, and the classification of the recent forms with those of the Mesozoic rocks, separated by so wide a gulf of geological time, though founded on the similarity of dentition alone, is the only reasonable one, as there is no evidence that the living and fossil Ceratodonts, differed from each other. The teeth of this genus resemble in general shape and structure those of *Ctenodus* which are widely distributed in Carboniferous strata, species occuring in America being identical with those of the British rocks of contemporaneous age. The dentition of the Devonian *Dipterus* is also closely related to that of *Ceratodus*, as well as *Lepidosiren*.

Thus the history of the *Dipnoi*, an order before the discovery of the Australian *Ceratodus* only represented by the mud fishes of Africa and South America, is carried back to remote geological ages, and the four living representatives, at present known, are found to be the survivors of a well defined and characteristic group of fishes first appearing in the Devonian age. They can be traced up from *Dipterus*, through the carboniferus *Ctenodus*, to the Jurassic Ceratodonts, and then the link is lost sight of until their lineal descendants reappear widely distributed on the surface of the present world. This is but an illustration of the truth that species which have the greatest vertical range in time have also the widest geographical distribution, or that a wide distribution proves the antiquity of the genus. It is certainly a very significant fact that the group of living fish most closely allied to the amphibian reptiles should be represented in the Devonian rocks, long before the most simply constructed amphibians appeared on the scene of life in the swamps of the carboniferous period.

The *Dipnoi*, as at present constituted, comprises the following families: *Protopterina*, *Ceratodontina*, *Ctenododipteridæ*, and possibly *Phaneropleuridæ*. They are closely allied to the Ganoids, and especially to that sub-order termed, by Professor Huxley, the *Crossopterygidæ*, or "fringe-finned," to be presently referred to. Dr. Günther, indeed, proposes to unite the dipnoids with the ganoids, as a distinct family; but Professor. Huxley considers that, though nearly related to that order, they yet possess many important differences.

It seems as if the *Dipnoi* had also some affinities with the group of fishes known as *Placoderms*, for a most remarkable fossil fish has recently been discovered in America, the dentition of which is almost exactly like that of *Lepidosiren*, except that it is about one hundred times greater. The genus *Dinichthys* was founded by Professor Newberry for the reception of this gigantic *Placoderm*, of which two species at least are recognised and graphically described by him, in Vol. ii. of the State Reports of the Palæontology of Ohio. They occur in the Huron Shales of the Upper Devonian series, where they seemed to have preponderated in number, fragments of over a hundred individuals having been detected while the remains of other genera are found more rarely in the same horizon.

The original specimens of *D. Terrelli* were destroyed by fire, but fortunately a photograph had been secured from which the plates exhibited were taken. The jaws of this "terrible fish" were each two feet long, the breadth of the head was about three feet, and the cranium was composed of massive bony plates, the solid bone of the occipital portion being three inches in thickness.

The length of the body is estimated by Professor Newberry to have been about fifteen feet, and its diameter three. The anterior was protected by huge dorsal and ventral shields, resembling, in general shape and structure, those of the genus *Coccosteus*, rendered classic by the pen of the lamented Hugh Miller. Very little is known with regard to the fins, "about six inches only of an apparently median fin, with well ossified rays as thick as one's little finger," having as yet been found, and, from the absence of scales, it is conjectured that the posterior portion of the body of the animal was covered with a tough skin, as in *Coccosteus*, a genus which possibly protected itself, like the modern sheat fish of the Ganges, by burrowing in the mud, watching for prey with only its mail-clad parts exposed. The powerful dentition of *Dinichthys* is suggestive of carnivorous habits, and probably being so heavily weighted by the thick shields encasing its vital organs it would be compelled to obtain food rather by cunning than by swift pursuit.

It is worthy of notice that the ponderously armed *Placoderms* had a comparatively short range in time, remains of the group being only found in the Silurian and Devonian rocks, thus it seems as though unable to cope in the struggle for existence with the lighter armed and more active race of ganoids which predominated in the Devonian waters, they died out, leaving no immediate descendants.

The vertebral column in the *Placoderms* was generally cartilaginous, a condition considered by some authors as indicative of a low organization, but as the quantity of bone composing their external shields was much greater than that forming the internal skeleton of the existing types of true bony fishes, and as traces of ossified caudal vertebræ have been discovered in one genus they ought rather to be highly plaed in a systematic classification. The group is considered by Professor Huxley to form a link between the Ganoids and the Teleosts, and as having most affinity with the living plated Siluroid Teleosts of the African rivers.

Distribution and Range of the Piscine Families in Geological Time.

In considering the distribution and range of the various families in a geological time, we find that authenticated remains of sharks, *Placoderms*, and Cephalaspids have been obtained from the Lower Ludlow Beds of the Upper Silurian rocks of Europe, but in America it is singular that no fossil fishes have as yet been discovered before the Devonian epoch, when the relics of numerous genera occur abundantly, differing, however, from the European forms.

This dissimilarity in the fauna is probably owing to the differences existing in the physical geography of the two areas at the time of the deposition of the series. The Devonian formation is built up of fresh-water, estuarine and marine strata, each group characterised by its peculiar forms of life. In the Old Red Sandstone of Scotland and Russia, fresh-water species predominate, while in the marine limestones of Devonshire, and the Eifel, Mollusca, Corals, and the remains of genera of inshore dwelling fish indicate a shallower marine deposit. The greater part of the American Devonian, on the contrary, was apparently laid down in an open sea, and thus a monster marine fauna flourished, not so generally represented in Europe, but it is interesting to note the identity of a few species occuring in localities where the beds are of similar structure to those of contemporaneous age in Europe. In both worlds the formation is alike distinguished by the great preponderance of ganoid over elasmobranchiate fishes.

The condition existing during the formation of the Devonian rocks are well illustrated at the present day by the fresh-water lakes, mighty rivers, and extended coast line of the African and American continents, and it is a most suggestive and significant fact that the genera of living ganoid and dipnoid fishes most resembling the palæozoic forms are now, with two exceptions, found on those continents alone. Taking the various orders of Professor Huxley's comprehensive classification in succession, we find that no traces of the first or lowest order, the *Pharyngobranchii*, which contains only the "gullet breathing" lancelet have been found in a fossil state. This is easily accounted for, however, by the soft and perishable structure of the species, of which no remains could possibly be preserved in the finest sedimentary strata, and, therefore, the non-representation of this lowest form of ichthyic life in "the records of the rocks" becomes less remarkable.

Of the cartilaginous *Marsipobranchii*, comprising the hag fishes and lampreys, the horny teeth alone would be susceptible of preservation, and their absence has been commented on as negativing the evidence of progressive development among fishes, as it is obvious the most simply constructed forms should appear first on the scene of life in order to give place to their more highly organised descendants.

In 1856, Pander, in his magnificent work on the Silurian and Devonian fishes of the Russian Baltic Provinces, gave numerous figures of what he supposed to be the teeth of small sharks, from

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The next order, the *Elasmobran*
fishes, rays, and *Chimæroids.* The
enjoyed a long range from the U
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in the Devonian, and live on, but th
until the Jurassic age. The *Placoderm*
but a transient existence, dying out at

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* Enc. Brit., vol. xvii., part 1, Art Palæon

while the *Teleostei*, or true bony fishes, which so largely predominate at the present day, did not appear on the scene of life until the formation of the Cretaceous rocks.* Seven, or eight, living genera alone survive of the *Ganoidei* which prevailed so numerously in Palæozoic times, and but one of these, the sturgeon, the least characteristic of the group, is found in European waters. Two of the six remaining forms, which are all dwellers in freshwater, occur in Africa, and four inhabit the lakes and rivers of North America. The preservation of the majority of living ganoids in America is probably owing to the fact that some portions of this ancient continent, truly the old world of *geologists*, have never been submerged since their upheaval from the first Silurian seas, thus some representatives of this ancient race of fishes were able to find a refuge in its bays and rivers, and the chain of descent has been kept unbroken from the early ages of the incalculably remote past.

The large spined, shagreen scaled *Acanthodidæ*, which are considered by Professor Huxley to link the ganoids to the Elasmobranchs, range from the Devonian to the Permian rocks. The "thick toothed" *Pycnodonts* lived from the coal measures to the Tertiaries, and are now extinct, while the buckler-headed *Cephalespids*, like the *Placoderms*, existed only in Silurian and Devonian times. The *Chondrosteidæ*, to which group the sturgeons belong, were certainly represented in the Jurassic seas, and possibly by the gigantic *Macropetalichthys* in the Devonian. *Amia calva*, the dog-fish of the American lakes, is the sole member of the sub-order *Amiadæ*. The *Lepidosteidæ* includes the living bony pikes, inhabitants of the rivers of the same continent, and fossil forms in all the formations reaching back to the Devonian.

There remains for discussion but the sub-order *Crossopterygidæ*, that important group of fringe-finned ganoids, through which * Professor Huxley considers the passage from the fishes to the reptiles took place. All the families of this well-defined sub-order are characterised by the possession of two dorsal fins, and by lobate paired fins having a central axis or stem covered with scales like the body walls, and surrounded by a fringe of fin rays. Jugular plates always replace the branchiostegal rays, and the scales are either rhomboidal or cycloidal. The families *Saurodipterini*, *Glyptodipterini*, and *Phaneropleurini* are restricted to the Palæozoic rocks. The *Caelacanthini* range from the Carboniferous to the Chalk and the *Polypterini*, comprising only the living *Polypterus* and *Calamoichthys* of Africa alone represent this numerous race of fishes at the present day. The genus *Polypterus* is remarkable for the unique arrangement of its subdivided dorsal fin, and by the possession of a double cellular air bladder, which most nearly approximates to the true lungs of the *Dipnoi*. It has least structural affinities with the *Cœlacanths*, its nearest allies in time, and is most closely zoologically related to the rhomboidal scaled *Saurodipterines* of the Devonian, from which it is separated by an enormous gulf of geological time, as no intermediate links have been discovered.

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* A species of Polyodon allied to the Sturgeon, inhabits the rivers of Northern China.

In the notochordal *Phaneropleurini* we find forms which most closely resemble the acutely lobate finned Lepidosiren. . The shape of the body, number, position, and structure of the fins, and all the elements of the internal skeleton, exactly foreshadow those of the mud fishes. Like them *Phaneropleuron* was covered with thin cycloidal scales, through which the long and well ossified ribs show so plainly in the fossil state as to suggest the name of the genus. The dentition, however, differs from that of *Ceratodus* and *Lepidosiren*, being composed of a row of short conical teeth in each jaw, and in the absence of the grooved dental plates so characteristic of the true *dipnoi* it is uncertain whether this family can be associated with the other members of that order. The chain of descent is carried on by the *Coelacanthini*, the only fringe-finned ganoids occurring in the Mesozoic rocks. They can be traced up from *Coelacanthus* in the Carboniferous, through *Holophagus* in the Lias and *Undina* in the Oolites, up to *Macropoma* in the Chalk. The family is distinguished by cycloid scales, hollow fin supports, and a notochordal skeleton built on the same principle as that of the mud fishes. In some genera the walls of the air bladder are ossified. this peculiarity, which was first suspected by Mantell, is especially remarkable in *Undina* and *Macropoma*, and can be observed in specimens of the latter in the Willett Chalk Collection. No fossil Crossopterygids have been discovered in Tertiary strata, but it is the opinion of Professor Huxley that as the rhomboidal scaled Saurodipterines of the Devonian rocks are now represented by the living Polypterus, so the stiff-walled lungs of the Lepidosiren are the homologues of the ossified air bladder of the Coelacanths, and thus that genus carried up the cycloidal branch of the Crossopterygids to the present day.

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* Decade X of the Memoirs of the Geological Survey, 1861 (Classification of Devonian Fish).

Such, in the abstract, is the life history of fishes, a class characterised, like other divisions of the animal kingdom, by the extinction of some groups after a brief existence, and by the persistent endurance of others through untold ages. In the few genera of living ganoids we have undoubtedly the surviving descendants of a numerous and powerful race which prevailed in the Devonian epoch, and by the discovery of fossil dipnoal forms the progenitors of *Ceratodus* and *Lepidosiren* the *Dipnoi* are likewise proved to be of ancient lineage.

Moreover, in considering the fact that the early fishes are remarkable from a combination of diverse characteristics which subsequently become the distinguishing peculiarities of distinct families, and of a higher order, we find further evidence that the ancient ganoids formed the parent stock from which the succeeding fishes, amphibians, and reptiles have diverged. In some sauroid Devonian fishes the position and structure of the teeth foreshadow those of the Labrinthodont reptiles, in others the throat is protected by gular plates, a fashion retained in the Carboniferous amphibia. Again, in some species the scales are surface pitted, like the scutes of Crocodiles. While, in the notochordal weak-limbed amphibians of the coal measures, with minute body scales, and partly osseous skulls, we cannot fail to recognise structural peculiarities now found in the swamp-dwelling mud fishes. Thus in the anomalous "scaled sirens," we have the "persistent type" of an ancient group of fishes, in which now, as in the old time, the piscine and amphibian characters are so united as to completely efface the line of demarcation between the orders, and effectually link the fishes to the reptiles.

A cordial vote of thanks was awarded to Miss Crane for her valuable paper. The vote was acknowledged by Mr. Crane; and then an examination of the specimens produced in illustration of the paper, and a conversation respecting the subject of it, was entered upon, the President, Mr. G. D. Sawyer, Mr. Crane, Mr. Wonfor, and Mr. Haselwood, taking part, and the latter suggesting the giving of a few elementary lessons in such sciences as that of which it treated, in order to better prepare some of them to appreciate them when discoursed upon.

FEBRUARY 22ND.

MICROSCOPICAL MEETING.—MR. T. W. WONFOR ON ARTIFICIAL DIATOMS.

It is well known to chemists that if fluor spar and sulphuric acid be mixed together in a platinum or leaden vessel, so as to form a paste, and gentle heat be applied, that fumes of hydrofluoric acid, which has a great affinity for silica, are given off. Advantage is taken of this property in the arts to produce etchings on glass. The operation consists in evenly smearing the surface of the article to be operated on with a coating of wax or a resinous compound known as etching ground. On this prepared surface the design is traced in the ordinary way with a pointed instrument. The glass is then placed, waxed surface downwards, in a shallow vessel of lead or platinum, in which finely powdered fluor spar and sulphuric acid have been mixed together into a paste. A gentle heat being applied, fumes of hydrofluoric acid are given off, which, coming in contact with the glass, produce the desired effect in a few minutes. The wax or etching ground is then washed off with oil of vitriol.

Again, if equal parts of finely powdered fluor spar and glass, or fine white sand, are mixed together, and water and sulphuric acid added, hydrofluoric acid will be given off as before, but coming in contact with the silica of the powdered glass or sand the acid will be decomposed, the result being water and a gaseous fluoride of silicium, known by the presence of white fumes; the whiteness being caused by the presence of minute particles of silex, arising from the decomposition of the fluoride on coming in contact with the aqueous vapour of the atmosphere, for it is an accepted fact that, if the gaseous fluoride of silicium come in contact with water, it is itself decomposed, and gives rise to silica and a double fluoride of silicium and hydrogen called hydrofluor-silicic acid.

In the *Quarterly Journal of Microscopical Science* for April, 1863, there is an abstract of a paper by Max Schultze on "The structure of the valves of diatoms, as compared with siliceous pellicles produced by the decomposition of fluor silicic acid in moist air." These pellicles, to which we propose drawing the attention of the Society, are produced by a modification of the process last described, and certainly bear in their markings such a resemblance to the markings on the valves of many diatoms as to warrant their being called "Artificial Diatoms."

To make the Artificial Diatoms, described by Schultze, a modification of the last-named process is necessary. Take a well-cleaned Florence oil flask; into this put about a teaspoonful of powdered fluor spar, and the same quantity of powdered glass. On this mixture pour sufficient sulphuric acid to form a thickish paste. In the Florence flask insert a loose plug of moistened cotton wool.

The cotton wool, if necessary, can be kept moist by taking another flask, filling it with water, dipping one end of a lamp cotton into the water, and allowing the other end to rest on top of the plug of cotton wool. Fluoride of Silicium, or, as it is now called silicic fluoride, will slowly rise in fumes from the mixture of fluor spar, glass, and sulphuric acid, and deposit a portion of the silica in the form of vesicles, very much resembling in shape sausage skins. Some of these vesicles, on examination, will be found to be quite plain, while others will be elegantly marked.

Before attempting to examine the vesicles, it is necessary to well wash and dry them, otherwise the moisture from them will corrode the glass of the objective, or damage the brass-work of the microscope.

They may be examined as opaque objects under a low power to obtain an idea of the general form and appearance of the vesicles. They may then be gently crushed on the slide under a thin covering glass, and examined with a high power ranging from a quarter upwards. Some will be found to bear a striking resemblance to the valves of diatoms in their marking; while others will exhibit large (comparatively) round bosses, with smaller bosses grouped around them. Max Schultze in his article suggested that the hemispherical and other markings were due to crystallization. This may possibly be the case. We certainly have examples of silex depositing itself in form of bosses and knobs, as well as those peculiar concretions mentioned by Mr. Pankhurst in his paper on "The Forms of Silica." We have also noticed similar minute bosses in pieces of disintegrated Roman glass from the Catacombs.

An interesting discussion followed, in which most of the Members present joined, after which objects illustrative of the subject of the paper, including real diatoms, chalcedony, disintegrated glass from the Catacombs, and crystals in glass were shewn by the President (Mr. G. D. Sawyer) and Messrs. Aylen, Glaisyer, Haselwood, and Wonfor.

MARCH 1ST.

THE ANNUAL SOIREE.

The sixth annual soirée in connection with this Society was held in the Royal Pavilion, and proved a brilliant success. This soirée is one of the most important events in the year's history of the Society, and is always looked forward to as an approaching pleasure, and afterwards regarded as an occasion on which thorough enjoyment and interesting instruction were combined. The sixth soirée was inferior to none of its predecessors in any respect, and superior to more than one. A large number of gentlemen connected with the Society worked indefatigably to secure a success, and they must have felt fully repaid by the result for all the "pleasurable trouble" they undertook. The magnificent rooms were tastefully decorated with plants and flowers by Messrs. Balchin and Nell, of the Western Road, and refreshments were supplied by Mr. E. Booth, of East Street, who laid the tables out in an artistic manner, and gave unbounded satisfaction.

On the tables in the several rooms were displayed numerous interesting objects of natural history. There were also exhibited microscopes, spectroscopes, galvanic batteries, and numerous other scientific instruments. The microscopical subjects were as follows:—Mr. Duguid, eel-like forms in vinegar; Dr. Massy, young oysters; Mr. Mills, palate of trochus; Mr. Welsh, nerve of tooth; Messrs. T. Rowley and Son, young jelly fish and other living objects; Mr. R. Glaisyer, diatomaceæ; Mr. Lethbridge, sections of kidney and coal; Mr. B. Lomax, tongue of blow-fly; Mr. Aylen, sulphate of copper; Mr. Hazelwood, frosted silver; Mr. T. W. Wonfor, skin of the tail of a mouse; Mr. Dennant, pasasite of bird; Mr. T. W. C, Wonfor, section of pearl; Mr. G. D. Sawyer (the President), spiculæ of gorgonia arranged to form a pattern; Mr. J. T. Gwatkin, section of cat's tongue; Mr. W. D. Savage, palate

of squid; Mr. Nash, section of cl
flea. Mr. R. Glaisyer and Mr.
interesting objects of the same cl
were vacuum tubes, revolving an
Capon; automatic spectroscope,
Nebula, in Orion, by Mr. H. Pra
from the alluvial deposits of the
Mr. T. W. Wonfor; foriegn butte
and foreign beetles, by Mr. A. Do
a continuous self-acting railway b
E. D. Smith; a beautifully carved
by Mr. H. Saunders; ammonites,
great age, including an ancient Gr
(mummy) from Memphis, by Mr.
of shells, by Miss Glaisyer; a stere
and some very beautiful pictures
Nash; peculiar looking Chinese
Chinese porcelain tea sets, lent by
curiosities of various kinds brought
from the Challenger Expediton.
exhibited the magnificent sword
mayoralty by the Sultan of Zan
Majesty's visit to Brighton in 1875.
also lent two splendid Japanese swo
strange looking objects which attr
They were Chinese gods and goddess
votive tablets from one of the tem
presented to a goddess by a high cla
and heir, and the other was given as
the inhabitants of 96 villages, for e
some particular complaint. During t
lectures were delivered, and were
company.

ADDRESS BY MR. G. D. SAWYER, THE PRESIDENT.

When your excellent Secretaries first communicated to me the wish of your Committee that I should become your President for this year, I confess that I had some natural hesitation in accepting your very flattering invitation. I have been so much more accustomed to the position of a learner than of a teacher in your scientific Society, and there are so many gentlemen well qualified not only to fill but to adorn the office of President, that I could not but feel doubtful how far the suggestion would be approved of, and be advantageous to the Society. Nevertheless, my constant attendance at your meetings during the last twelve years as a Member, and for seven or eight years as one of your Committee, has given me so deep an interest in its proceedings, and I am always so happy when associated with its Members, that I could not refuse myself the pleasure. Also (for it is never very difficult to convince one's self of what one wishes to believe), it seemed to me that the responsibility of the selection would after all in no sense rest upon me. And therefore I am here to-night to welcome you to the sixth annual soirèe of our Society, and in the name of the Committee to express the hope that you will have a very pleasant evening's enjoyment.

I have been strictly enjoined not to occupy much of your time by any prefatory remarks of mine; and however much I might have enjoyed wandering with you along some of the pleasant paths of natural history, I must show my obedience to discipline by yielding to the "powers that be," and by keeping you but a very short time from the enjoyment of those capital lectures, interesting microscopic slides, and attractive objects which our kind friends have provided for our entertainment this evening. But I must be permitted to call attention very briefly to some of the advantages afforded by our Society, that such of you as have not yet joined our ranks may be induced to do so, and thereby extend our usefulness.

The essays and papers read
in the past have manifested great
on the part of the writers ; and
followed, facts have been elicited,
that have added materially to the
to the quick perception of even tl
joining in the intellectual conflict.
favoured with a paper by Mr. B.
of Certain Numbers in Nature,"
interesting than the title indicated
ideas to think about. Soon after t
A. Pankhurst, favoured us with o
lectures, taking as his subject, "Sc
our warm friend, the Sun, and not
showing us (by the aid of the lime
his fine open countenance, and
eccentricities.

If time permitted I should in
salient points of his admirable add
to the majestic size of the sun—n
size of our earth—to its attractive
and fifty times the weight of all th
—to the opinions held as to the c
its depressed sun spots and its el
corona and rose-coloured protubera
to the enormous space occupied by m
as carefully explained by our lectu
only say that the importance of the
the diagrams, and the clearness of tl
be desired ; and I allude the more
longing to hear the lecture that M
promised to give us this evening o
listening to which I can safely promi
ordinary meeting last month, we had
listening to a carefully-prepared pa

additional attraction of having been prepared by a lady. Miss Crane prepared, and our worthy Secretary, Mr. Wonfor, read this excellent paper on "Certain Genera of Living Fish and their Fossil Affinities." It exhibited great research, and showed an extensive acquaintance on her part with her subject. To add to the interest of the address, Miss Crane had personally prepared a large number of explanatory diagrams, by which the subject might be very readily understood. Her great talent manifested in preparing the subject matter of this lecture, and the diagrams accompanying it, much impressed those who had the privilege of hearing it; and quickened in them the desire and the hope that this lady will at some future time favour us with other valuable contributions to our Society's usefulness.

These are only a few specimens of the advantages offered in the opportunity of hearing valuable essays and discussions thereon. But for being short of time—so "cribbed, cabin'd, and confined"—I should have liked to enlarge on the advantages of the very well-selected and costly library possessed by the Society, the books from which can be taken by the Members to their own homes, and there carefully studied. In it will be found the best text books on chemistry, geology, entomology, pylhsiology, zoology, and many another "'ology." The birds, beasts, and fishes are well represented there, and the microscope has a large amount of light thrown upon it by the valuable works on the shelves of our library. Leisure hours may indeed be well and pleasantly occupied in the study of its contents, for there may be found ready to hand stores of matter prepared carefully by sages and philosophers, to acquire which in any other way would quite overtax the time and the powers of students, although they might have ever so great sympathy with, and feel ever so great interest therein. There is a well-prepared catalogue of the library made up to quite a recent period.

Then the admirable yearly report handed to each of the Members, and containing a well-digested epitome of the papers read, and the facts elicited during the year, is another advantage of the Society which is highly worthy of notice, and the microscopical meetings held every month. What a fund of instruction and deep interest do these furnish. Even apart from the higher uses of the microscope in scientific investigation, it has been well said that the use of the microscope is "one of the most pleasurable recreations that human ingenuity has devised." I strongly recommend it to you all.

And now I *must* stop, although I have said nothing yet about our pleasant rambles together in the lanes and meadows—the woods and pastures of our beautiful country—in our "field excursions." These are indeed a privilege. And last, though "not least," our highly popular "annual excursion.' To understand the delight to be obtained from *this* you will really have to come and experience it, for neither my time nor my powers will enable me to do justice to this part of my subject. And now permit me to ask if I have established my declaration that the Natural History Society *is* worthy of your support. If so, I will conclude by thanking you for the kind attention with which you have listened to these few introductory remarks, and ask you to join with me in very heartily wishing a long career of usefulness and increasing prosperity to the Brighton and Sussex Natural History Society.

Shortly after the close of this address Mr. E. A. Pankhurst delivered a lecture, illustrated with the lime light, on

COMETS AND NEBULÆ.

He said: Many of you doubtless saw in the newspapers not long since a paragraph with the startling heading, "A world in Flames;" and truly a world, a sun, did blaze out in fiery eruption, so intense, so stupendous that the naked eye could catch the gleams of it across an abyss of space to us immeasurable. And now that sun is becoming an almost invisible speck even to our large telescopes. It is quite possible that we saw its last ading fires, and that it will never again take its place as a star in our heavens. That was but one instance, though a striking one, of that mutability to which suns and planets are subject as well as the rocks which form the earth or the weed which grows in their crevices. This constant "becoming" and passing away is the law of the existences which people the infinitude of space above us, no less than of mortality. The question then may be asked out of what do they arise, and into what do they pass? In what faint nebulous matter do suns have their birth, and into what dust are they at last dissipated.

Science, as yet, cannot answer this with precision, but there are intimations that at no distant date the problem will be solved. I have taken upon me, therefore, this evening to direct your attention to the dust and gaseous matter of the universe, and to the changes which it undergoes. These clouds of luminous gas or more solid particles we will consider under two aspects, moving and stationary. When in motion we term them comets, when at rest nebulæ. Occasionally the astronomer perceives in the far away depths of the sky a small, faintly luminous spherical body. He discovers that it is travelling comparatively slowly towards the sun. As it nears that great controlling mass its velocity is accelerated; at the same time it undergoes extraordinary changes. Jets of luminous cloud are by some unknown forces evolved from the nucleus and driven back like jets of steam from a locomotive on its road. These form what we term the tail. At last a luminous train, attaining perhaps a length of one hundred millions of miles, blazes across the sky. These long filaments of light do not always coalesce with the main portion of the train. This was the case with the great comet of 1858. Two successive appearances of that comet are now on the screen. Those of you who remember it will see but a faint adumbration of its splendour in the picture now before you. All comets, however, do not evolve a tail; nor are they restricted to one. The comet of 1744 had six tails. Their forms are as singular as manifold. Some have not even a bright nucleus, though the generality of them are so distinguished. In some the nucleus is of extraordinary brightness, shining with the brilliancy of a star of the first magnitude. Not only was the nucleus of the great comet of 1843 visible in broad daylight, but also a portion of its tail. The comets of 1577, 1680, and 1769 were remarkable for the intensity of the light emitted by the nucleus. Not less uninteresting than the method by which the tail of a comet is formed are those changes in the nucleus which produce the envelopes which surround it. This is well illustrated by the beautiful drawings of the comet of 1861, now on the screen. They were made by Mr. Warren de la Rue, on the 2nd and 3rd of July. Under the sun's influence, the nucleus peels or throws off envelopes, as the different layers round an onion peel off, and these are gradually expelled into the tail. These successive phases which the comet of 1858 underwent in this respect are exquisitely delineated by the same accomplished astronomer. Now, although, as a general rule, comets, as they approach the sun, become more brilliant, and acquire a luminous train, yet in the case of Encke's and Halley's the tail and coma *decreased*. We will throw upon the screen, in illustration of this, Halley's comet, as it appeared at an interval of 13 days in 1830.

But still the question remains, whence come these strange visitors? To what laws are they subject? Whither are they bound? Of what substances are they formed? The greater number of those that have been observed belong undoubtedly to the solar system. They circle in cloud orbits round the centre of our system, thereto constrained by that bond of gravitation which controls the planets. The periods of revolution vary enormously. Encke's comet performs its revolution in 3¼ years, Halley's in 76. The period of the comet of 1680 has been calculated at nearly 9,000 years; that of 1814 at 100,000. Some again have never returned, and probably will never revisit our system. They have escaped from our sun's control, and plunging into the infinite abysses of space, have fallen within the sphere of attractions of other suns than ours. They thus may become wandering messengers as it were, passing from one system of sun and planets to another. Encke's comet, on the other hand, is getting nearer and nearer the sun with each revolution, and in the course of time must be absorbed in its fiery mass. The orbit of a comet is vastly more elliptical than that of any planet, at one time approaching the sun, perhaps, till the heat it receives from it, as calculated by Sir I. Newton, must render it 2,000 times hotter than red hot iron, and then passing away into frigid depths of space to an unimaginable distance. It will not surprise you, then, to learn that while the sun's power, as the comet approaches it, initiates such marvellous changes in its form, as it recedes its light diminishes, and its luminous train is absorbed. It becomes again that faintly luminous spherical body that it first appeared to us. And now the substance of which these strange wanderers are composed—is it gaseous or of solid particles? Do comets shine by their own light, or like the planets, by the light reflected from the sun? The spectroscope in the hands of Dr. Huggins solved that problem some years ago. It was found that the nucleus was a glowing incandescent gas. Nay, he can even tell us what gas was then glowing.

The spectra obtained from it was almost identical with that given by a hydro-carbon. Other observers differ slightly in their views with regard to the spectra of comets; but all concur in the conclusion that carbon is present in the bright central portion of the head of the comet. By the same means it was proved that the tail shone by reason of the light reflected from the sun. That it was composed therefore of comparatively small particles, which were illuminated by the sun's rays as a cloud of chalk dust on a summer's day. It must not be understood, however, that the particles of which the tail of a comet is formed are as fine as such particles of dust. Bodies as large as a billiard ball or a brick would be but as fine dust compared with the enormous dimensions of such a congeries of them as the tail of Donati's comet. What would happen if the earth were to encounter such atoms in its course? Moving at the enormous velocity that these move with, the majority of them would be kindled into flame by friction against its atmosphere. You have all of you seen such phenomena, and you have spoken of it as that of falling or shooting stars. These too, as you are aware, come sometimes in showers.

Every August and November, and April, the earth passes through huge shoals of such moving particles, as they pass onward in their revolution round the sun. Every 33 years a swarm of meteoric bodies crosses the orbit of the earth, and then the sight is not easily forgotten. Some of you may, perhaps, remember the night of the 14th of November, 1867. Those who do not will see but a poor picture of its splendours in the one now on the screen. The earth then passed through that great system of meteors which must have been at least one thousand millions of miles in length, and probably a million miles in width. You begin perhaps to suspect that there is a closer connection between shooting stars and comets than you had anticipated. And, truly, the discovery of the relation between them is one of the great glories of the astronomical research of the last few years. It has long been known that these meteor-systems travelled in very eccentric orbits, just as comets do, but it was left for Professor Schiaparelli, of Milan, to show conclusively that the elements of the orbits of two comets, Biela's and Temprel's, were almost absolutely identical.

The exact relation between comets and these streams of cosmic dust is not established with precision, but they are so intimately associated that we may regard these showers of meteors as at least the dissociated granules of that which was once a comet. Astronomers have determined the paths of more than one hundred meteor systems. It has been calculated that more than seven millions of shooting stars or meteors dash into the earth's atmosphere every twenty-four hours. The lowest computation that I have seen puts the comets which belong to our solar system, that circle round our sun, at seventeen millions.

What becomes of these vast streams of tiny particles? Whence come they? Whither do they tend? What use do they subserve in the economy of the universe? Time will not serve this evening for the discussion of all these questions, tempting though they may be. There is still ample room for speculation when our positive knowledge is exhausted. It is worthy of remark, however, that these systems of meteors must be enormously more crowded near the sun than at a distance from him. That a halo of nebulous light surrounds the sun, which is seen with singularly beautiful effect during eclipses. Further, this light is sunlight reflected from solid particles. Enormous muititudes of these particles are doubtless drawn within the sphere of his attraction, and go to increase the light and heat which he dispenses to the worlds around him.

And now permit me to address myself for a few minutes to the question—whence come these comets and meteor streams? Far beyond the limit of the sun's enormous mass, at an almost unimaginable distance beyond the orbit of the furthest planet of our system, there exist masses of nebulous, faintly luminous matter, scarcely perceptible, even the brightest of them, to the naked eye. By means of the telescope, however, five thousand such nebulæ have been discovered. For a long time it was debated whether these faintly luminous objects were not really clusters of stars rendered indistinct by their enormous distance. As telescopes increased in size and magnifying power many of these starmists were resolved into such masses of congregated suns. The appearance which the celebrated Dumb Bell nebula in Orion presents when viewed through telescopes of different powers is now before you. Lastly, behold it as viewed through the enormous telescope of Lord Rosse, and mark that what was before but a cloud of light becomes in this an aggregate of a thousand radiant points. Seeing that this was the result of viewing these nebulous masses by means of increased telescopic power, it was thought that by-and-bye all nebulæ would be resolved into stars.

But here, too, the spectroscope has come to our aid, and thus analysing the light from these far distant sources we affirm that many are really vast cloudy masses of incandescent gas. Let us look at some of these nebulæ, and mark their varied and singular forms, and note some relations between the brilliant nuclei, and the gaseous matter surrounding them. Before you is what is called *par excellence* the great nebula of Orion. I cannot tell you over how many millions of square miles it stretches. The extent of it is almost unimaginable. In the centre is a group of seven suns which belong to one system. In their immediate neighbourhood is a rectangular mass of brilliant cloud, in which clusters of stars have been discerned, or we will put it, that in certain points the light is more condensed than in others. Now it is very certain, that since this nebula was first discovered in 1656 it has undergone changes in form and in the brightness of its different parts. As remarkable, perhaps, as this nebula in Orion, is the one in Doradus now before you. This belongs to the class of large, irregular nebulæ, but still in the bright annular masses of its central portion we see the evidence that its molecules are being marshalled into a definite organization. On the outskirts its shapeless cloud-masses seem torn into streamers and filaments, as if by the force of tempests. Another remarkable nebula of irregular outline is that in Taurus. As seen through Lord Rosse's telescope, it presents the form now shown to you, resembling, perhaps, a gigantic lobster more than anything else. The claws and antennæ are here star-streams. But these luminous clouds often take forms much more symmetrical than those that have been shown. Who can look at this beautiful nebula of the Lion, and in the spiral concentric layers of luminous matter in its centre, and not see the gathering of a shapeless mass into the first outlines of a definite form.

But it is in what are termed the planetary nebulæ that we have this definite form most strikingly presented. Here in this one, in the constellation Andromeda, we have a brilliant luminous ring with a fringe of cloudy light on its exterior, and also in its central portion. In this one of Ursa Major you see a double crown with two brilliant nuclei and a fringed border. The nebulæ we have so far dealt with are, as we know by spectrum analysis, mainly composed of incandescent gas. They lie, as I have said, far beyond the limits of our solar system. Their distance is incalculable, unimaginable. Great changes have been proved to take place in them. Scattered over most of them are brilliant points of light were the gaseous atoms are condensed into masses of intense brilliancy, and doubtless enormous size.

Are these glittering nuclei suns? Do we watch here the growth of a world-controlling luminary similar to the great centre of our own system? The question is not finally answered. Yet in the remarkable changes which the nebula surrounding a well-known star in the constellation Argus seem to favour such a view. In the opinion of the astronomer at Melbourne, the star increases at the expense of the nebula surrounding it. Far as these luminous clouds are beyond our system, yet it must be remembered that the sun himself and the planets that circle round him are moving through space at an enormous speed. Portions of these fiery clouds would thus be brought within his influence, and be forced to revolve round him. A new comet would come within the ken of the dwellers on this spot of earth, and some cooled, condensed fragments might find their way to its surface. But there are nebulæ undoubtedly composed of vast numbers of glowing liquid or solid bodies, and among all the wonders of the sky few are more wonderful, more suggestive than these. Regard for a moment this prodigious spiral of stars. Look at this brilliant mass in its centre. Under a powerful telescope these drifting masses of seeming cloud resolved themselves into star-streams. The atoms of this light-giving vapour are themselves worlds. Here, again, are clusters of suns whose concentrated light, dimmed by enormous distance, seems to us but a faint luminosity. In the cluster in Hercules, here represented, there must be at least five thousand suns. Many of these were at one time thought to be clouds of luminous gas, but increased

magnifying power has reveal
masses of stars. What move
off systems we know not. V
this star-mist, concentrating it
pating it there into filaments c
this we see, that not even in
stars, is there anything perman
longer visible now that once we
to increase in brightness and
points in their centres, once cl
found. Rest there is none.
energy, with life to the farthes
atoms of the luminous cloud co
streams, and star-streams form
are again dispersed. Out of th
are built up, as the decaying l
flowers of spring. Perchance, a
the same law guides the spiral
the vine—

> "One God, one law,
> And one far-off div
> To which the whol

At half-past nine o'clock, Mr.
at the Brighton School of Art an
trated with interesting experiments

"PARADOXICAL

The selection of the title of this
me much less trouble than the findi
the title was selected. One consolat
with such a "paradoxical" introducti
consecutive and orthodox lecture.
subject, I would refer to some of the
known; and one of these which seem
that which results from tha action of

(Potassium burned in water.) This experiment reminds the lecturer of some juvenile experiences of a chemical student, who shall be nameless before this audience. That young gentleman, in the ardour of his youth, was in the habit of indulging in chemical investigations in the drawing room to the deterioration of furniture and the general discomforts of the household. After repeated warnings that this was not to be tolerated, the parental authorities resolved on confiscating, accordingly, the limited stock of chemicals in the possession of the said young gentleman, and all, as is the rule in these cases of the most dangerous character, were seized. Among them was a bottle containing phosphorus ; this happened to be the first, and was thrown in the fire. The result was a conflagration almost worthy of the pyrotechnist of the Crystal Palace. To make assurance doubly sure, the remainder were taken to the back yard, and the process of throwing down the drain was commenced. The lot to be selected for this fate, however, was a bottle containing this same substance—potassium—which has been brought before your notice to-night. The result of this expedient needs no comment.

This is a property not only possessed by potassium, other metals also act similarly; so also does a substance known as calcic phosphide. This has met with a useful application in signalling at sea, as this substance is the body used in the manufacture of Holme's signal lights. In these cases it is not the water which burns, but a chemical action takes place which liberates a combustible body, and the heat produced suffices to cause ignition. We find, on the other hand, that certain substances are protected from combustion while under water, but on rising to the air ignite spontaneously. As an instance, phosphoretted hydrogen may be mentioned. The flash of light resulting from each bubble, and the beautiful wreaths of smoke, are especially noticeable. Flame is not dependent for its existence on atmospheric air, or its active constituent oxygen ; combustion takes place in other gases, among them chlorine.

Spontaneous combustion of
as an instance. To proceed a st
produced actually under water, a
phosphorus, and potassic chlorate.
we have not been producing light
burn, neither is it possible for ma
ever, he may do, and that is to ca
and produce the resultant light
instance of this may be mentioned
is carried on in our battery, wher
the resulting effects before us on
no air for its support, and may be sl
may be shown in a vacuum, by m
prepared vacuum tubes.

Ordinarily light and flame are
this is not necessarily the case. W
and indeed some of our most inte
Iron burns in oxygen with brilliant
no flame. Flame is produced when
ever, a solid is burnt we have mere
and heat necessary companions in
heat is produced by the combustio
We have, however, but little light ;
matter as lime we get a light almost
It is self-evident that the heat must
denser a body the greater the light
temperature. Tyndall's researches
shown that the majority of the heat
accompanied by light. One or two
flame must now be mentioned. Fla
of musical sounds ; a jet of hydrogen
a clear musical note. Flame may n
source of sound, but it also possess
property. Under certain conditions i
its own peculiar manner. A flame l

droops at a sound almost too faint for ordinary ears. And now I have another point to introduce.

Various substances have been produced from time to time as sources of light. We may in fancy travel from the philosopher of Laputa, mentioned by Gulliver, who attempted to extract sunbeams from cucumbers, and hermetically seal them up and store them for future use, to such projects as laying a gas main across the Atlantic, and thus bringing over our supply from a natural source. I venture, however, to propose another substitue, and more, I am quite willing to give the benefit to any person or persons wishing to speculate. The substance I propose to burn, is neither more nor less than ordinary atmospheric air. This is certainly sufficiently plentiful and cheap enough to satisfy the desires of the most economical. Nothing is easier than to cause ordinary air to burn, provided we supply it with a suitable atmosphere. Such an atmosphere is found in hydrogen or coal gas. (Jet of air burned in coal gas; description of apparatus). This experiment is merely a reversal of the ordinary conditions, and shows us that supposing our atmosphere consisted of coal-gas or other combustible, air would then be the so-called combustible body and coal-gas or what-not the supporter of combustion. Heat and light in these cases are really but the results of chemical action, and it matters not which substance is present in greatest quantity, the action is the same. (As an instance of brilliant combustion the time-honoured experiment of burning phosphorus in oxygen may be introduced.)

A few words more before conclusion. From the very nature of the subjects now treated, this discourse has necessarily been abrupt and disjointed. Many phenomena have been referred to, and time has not permitted their explanation. On behalf of the institution I have the honour to represent, the Brighton School of Science and Art, I wish respectfully to urge its claims upon you. There is scarcely a trade or profession where knowledge of these subjects is not an immense advantage, and in many an absolute essential. The wants of such are amply met in the instruction there given. To those who see in the observation of Nature's wonders and secrets something which makes humanity better, happier, and wiser, abundant opportunities are offered of studying and investigating the laws and beauties of physical science. And to those who love art tor its own sake, and take pleasure in delineating the beauties of form with which we are surrounded, means are provided for so doing with all the aids which modern advancement and knowledge supply, combined with examples of those miraculous works of art which have made the names of ancient Greece and Rome immortal.

During the evening an interesting address was delivered by Mr. BENJAMIN LOMAX on

A CUP OF TEA.

Mr. LOMAX said that the "cup of tea" was the one institution about which all the civilized world agreed. The lady of fashion entertained her friends at a "drum" with a harlequin "cup of tea;" and the old woman in the almshouses chatted over the same stimulant. In Australia the bushmen had for breakfast damper, mutton, and tea; for dinner mutton, tea, and damper; and for supper tea, damper, and mutton. When a bushman travelled he carried tea; if he entered a house he was offered tea; and if "at night he sleepless lay" he rose to smoke and take "a cup of tea." For all this it was a fact that few knew a good cup of tea when they tasted it, and still fewer knew how to make it or even to drink it. Tea, as we had it, was the leaf of a Chinese shrub. Other countries drank other infusions—coffee. *matè*, &c.,—but all were chosen for the presence of one ingredient, called by the chemist, *theine*.

In England we were content with its weak presence in an infusion, but other people boiled it out, or ate the tea leaves; a sure, if unpleasant method of extracting the virtues and vices of this aromatic principle. The peculiar flavour of tea was due to the presence of a volatile oil, which he proceeded to distil from a strong tea infusion. The smell and taste of this oil were in its concentrated form disagreeable, but unmistakeably *tea*-like. It was, in fact, a poison, capable of doing great mischief to stomach and brain. Another principle in tea was the well-known tannin, by which the drinkers of strong tea tanned their mucous membrane. Pouring a solution of an iron salt into tea, he produced a black liquid, which was, in fact, common ink, and stated that those delicate ladies who took steel drops on rising, and breakfasted on tea and toast, were but porcelain ink bottles, white outside and black within.

The different varieties of tea were not, as was often supposed, the produce of different shrubs, though a delicate kind called imperial tea, which was never exported, but which he had drunk and much enjoyed at the house of a mandarin, was grown from a slightly different variety. The difference between Hyson and Souchong, Bohea, and Pekoe, was, in fact, that between the same leaf gathered at different times, or dried in a different manner. Those who tried to preserve flowers often found that delicate colours could be fixed by the use of a hot flat iron, and in like manner the green tea was made to preserve its colour by rapid drying, while the black was subjected to a more tedious process. Leaves plucked while young were delicate and juicy, those of older growth were strong flavoured. Others, as the Orange Pekoe, contained the flavouring matter of other plants.

We could not say of these varieties that one was better than the other—it was a question of taste. But adulteration was another matter. In China tea was often mixed with "devil's dust," the filthy sweepings of the warehouse. Such tea, allowed to float in cold water, would contribute sand to the bottom, dust and wool to the top, and often animalculæ to the middle of the tumbler. High coloured tea, wrapped in a handkerchief and steeped in warm water, would often dye it blue, showing that indigo or Prussian blue had been sprinkled over the leaves.

Sometimes a drop of ammonia would stain a teacup blue, shewing that the "green tea" was really old tea leaves dried with copper. Against such adulterations the best safeguard was to buy of respectable merchants, and to be content to pay accordingly.

In China tea was made in the cup, and drunk without milk or sugar, but in England we corrected the astringency by milk and sugar. The idea of substituting cream was, in the lecturer's opinion, absurd. The object was to flavor the tea, not to drink insoluble curds.

It must be remembered that milk could be adulterated even in the feeding of the cow, and an undue supply of water, with diminished food, might profit the dairyman, but was decidedly bad for the cow and for the cup of tea. The sugar should be crystalline, not necessarily loaf sugar, which dissolves slowly, but certainly not a coarse brown sugar containing uncrystallized molasses. The lecturer then explained the process of preparing sugar, and showed how water could be made to boil at a very low temperature by creating a vacunm. Thus, he explained, sugar was allowed to boil without being heated to an extent that would destroy the crystals, and these crystals when formed were separated by centifrugal force from the uncrystallized portions. After making a rough imitation of the mode of preparing candy, he proceeded to detail the precautions necessary to prevent the tea from being made weak by want of heat or bitter by too much heat. The water should boil but not gallop. The tea should be drawn in the usual manner with a small quantity of boiling water, and no tea should ever be warmed up after standing on the leaves. Moreover, the palate should not be spoilt by sweets or any aromatic taste before drinking tea.

A cup of tea, drunk warm but not hot, was a safe stimulant to mind and body, often causing food to assimilate, and thus being indirectly food itself. Much of the evil laid at the door of this beverage was caused by the foolish habit of drinking very hot liquids, but tea in excess was very prejudicial. Besides the mistake—not a slight one—of taking too much fluid into the system, strong tea, often taken, stimulated the brain to unhealthy action, caused want of sleep, or a sleep more active with dreams than wakefulness itself. He would engage, by the administration of essence of tea, to render the bravest man too nervous to sit up at night alone. This, however, was the abuse, not the use, of tea In wholesome moderation, it cheered the sorrowful, refreshed the tired, and soothed the afflicted. Our warmest affections, our happiest thoughts, were called forth at the tea table, and, with their permission, he would himself desist from talking, and refresh himself with a cup of tea.

MARCH 8TH, 1877.

ORDINARY MEETING.—MR. HERBERT GOSS, F.L.S., ON "THE INSECT FAUNA OF THE RECENT AND TERTIARY PERIODS, AND THE BRITISH AND FOREIGN FORMATIONS OF THOSE PERIODS IN WHICH INSECT REMAINS HAVE BEEN DETECTED":—

So little has been written in this country on the subject of Fossil Entomology that I presume that some contributions to our knowledge of it may not be unacceptable.

In this paper I shall endeavour to bring the results of recent investigations and researches under the notice of this Society, in the hope that they may have the effect of directing increased attention to an undoubtedly interesting and important branch of Palæontology, which, until a comparatively recent period, had received but little notice on the Continents of Europe or America, and still less in this country.

There can be little doubt of the importance of an acquaintance with the insect fauna of former times, for when we consider that insects are inhabitants not only of the air and the

land, but also of the water, it is
fossil state must be of the greates
accurate ideas of the geologica
past ages.

The investigations and publ
living Palæontologists, Professor
that the study of the remains of
numerical proportion existing
Herbivorous species of any form
the present day between the s
the world, will materially assist u
as to the nature of the vege
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of so eminent a Geologist a
usefulness of an acquaintance
valuable not to be here quoted.
Sir Charles observes "that the c
(*i.e.*, the fossil insects of Œning
incline us to believe that if this
so rare and local, they might be
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The fossil remains of the
Crustacea, and even the Radiata,
but notwithstanding the evident
it is only in comparatively recen
begun to receive attention. M.
the amount of attention besto
the Animal Kingdom, observes
been made as early as the
Century to "*Entomolithes*" it
Brullé, in an inaugural address
de Paris," called attention to the
from the study of Fossil Insects.

It must not, however, be

observations that this branch of Palæontology had received literally no attention whatever prior to 1839. Reference is made to fossil insects as long ago as 1700 in Scheuchzer's "Herbarium diluvianum," and Linnæus gave the name of "*Entomolithes*" to those petrifications which presented traces or remains of Insects; then, in 1726, a book, by Beringer and Hueber, containing reference to this subject appeared; this was followed in 1729 by Bromell's "Lithographia Suecana;" in 1742 by the "Historia Succinorum" of Sendelius, and in 1779 by Schröter's "Lexicon."

Nothing more worth noticing then appeared on this subject for about 50 years, when, in 1829, M. Marcel de Serres produced a very important work on the fossil invertebrates of the Tertiary formations of the South of France. In the same year (1829) a valuable contribution to our knowledge of this branch of Science was made by the late Mr. John Curtis, in a paper on the "Tertiary formations of Aix," by Murchison and Lyell. The next book worth mentioning, which treated of this subject, was Bronn's "Lethœa Geognostica," published in 1835.

One of the most valuable works on this branch of Science, and which has perhaps more than any other directed the attention of geologists to its interest and importance, is Professor Heer's "Die Insecten fauna der Tertiärgebilde von Œningen und von Radoboj in Croatien," published in 1847. Professor Heer has done more for this branch of Science than any other Palæontologist, and has been justly styled by Signor Massalongo "the Cuvier of fossil Entomology."

Amongst the names of English investigators of, and writers on this subject, the most prominent is that of the Rev. P. B. Brodie, M.A., F.G.S., who in 1845 produced the *only book* on fossil insects which has appeared in this country. Several papers on the subject have also been written by the Rev. F. W. Hope, F.R.S., Professor Westwood, F.L.S., Dr. Mantell, Dr. Henry Woodward, F.R.S., Mr. Vernon Woollaston, F.L.S., Mr. Arthur Gardiner Butler, and others.

In America some attention has lately been devoted to fossil insects by Dr. Dawson, F.R.S., Professor Denton, Dr. Horn, Mr. Mead, Professor Dana, Mr. Richardson; and especially by that distinguished Entomologist, Mr. Samuel H. Scudder, to whose numerous writings, especially his exhaustive essay on "Fossil Butterflies," recently published in the Memoirs of the American Association for the advancement of Science, constant reference will be made throughout this paper.

Among other important contributors to our knowledge of fossil Entomology must be mentioned Gravenhorst, Charpentier, Giebel, Carl Von Heyden, Lucas Von Heyden, Saporta, Ehrenberg, Pictet, Unger, Berendt, Germar, Goldenberg, Boisduval, Hagen, Von Münster, Massalongo, Van Bénéden, Preudhomme de Borre, Adolphe Brongniart, &c.

I now propose to refer briefly, in the descending order of Geological succession, to the various British and Foreign formations of the Recent and Tertiary Periods in which remains of insects have been detected, and to enumerate, as far as possible, the several orders and species to which such remains have severally been assigned.

Before doing so, it will be desirable to make a few observations on the probable circumstances under which insects became embedded in certain strata in which their remains have been discovered.

The estuarine and purely fresh-water formations are, as would naturally be expected, those in which the remains of insects have been found in the greatest quantities, but their remains have also been discovered, and in some cases in considerable numbers, in Marine formations, such as the Stonesfield Slate of England and the Solenhofen Slate of Bavaria. Their presence in such formations may be accounted for by supposing them to have been blown or washed out to sea from some neighbouring land; or to have been blown into the sea when attempting to cross it, and then, sinking to the bottom, have become embedded in the sediments there accumulating.

It is well known to all Entomologists that insects migrate in vast armies, frequently crossing the sea to effect their purpose.

Pieris Rapæ (the Common Garden White Butterfly) has been known to cross the Channel from France to England in a dense swarm. On this subject an eye witness has written, "Such was the density and extent of the cloud formed by the living mass, that it completely obscured the sun from the people on board the steamer for many hundreds of yards, while the insects strewed the decks in all directions."

Mr. Bates in his book on the "Amazons" mentions several instances of the flights of insects over the sea. Swarms of locusts have been observed many hundreds of miles from land, and moths, dragon flies, and other insects, have alighted on the decks of vessels in mid-ocean. The occasional presence of fossil insects in Marine formations may be thus accounted for; but where their remains are detected in any abundance in such formations, the proximity of dry land at the time of their deposition may be generally assumed.

Wherever insects have been discovered in a fossil state the *Coleoptera* are generally very numerous. This is easily accounted for by the hardness of their elytra.

The comparison of existing species of insects with the fossilized fauna of the ancient world, and the study of their Geographical distribution, is one of the most interesting features in this branch of Science. It is worthy of note that the insects, even from the older strata *(e.g.*, the Lias) are far more closely allied to those now in existence than the rest of the fauna of the Ancient World, and although some of them cannot be identified with any living types, still there is, as Mr. Brodie observes, "a much less proportional difference in this respect than might fairly be expected; so that these fossils may be almost said to afford an exception to the usual conclusions which have been derived upon this subject."

It is evident, from a comparison of fossil insects with existing species, that the temperature of Europe has undergone sensible modifications; and the distribution of genera, the size of the specimens, as well as the numerical relations existing between various groups, indicate the former existence of warmer climates than those now prevailing in the same parts of Europe.

Professor Heer has noticed that the development of insects has been influenced by that of the Vegetable Kingdom, certain species not having appeared prior to the period at which dicotyledonous plants are supposed to have attained their highest state of development.

It has been remarked by M. Oustalet that each formation, or rather each deposit, on the Continent, in which fossil insects have been detected, is characterised by the prevalence of some particular family or order. Thus the genus *Blatta* is especially well represented in the Lias of Aargua, the *Rhynchophora* in the Marls of Aix; the *Buprestidæ* in the quarries of Œningen; the *Ants* in the sulphurous marls of Radoboj; the *Termites* in the Baltic Amber, &c. This seems satisfactory evidence that each one of these groups found in its locality, at the period of its existence, all the essential requisites for its development.

I have a good deal to say on this subject, as well as on that of the dates of apparition of the various orders of insects on the Geological horizon. I shall, however, reserve my observations until the end of the 3rd paper of the series, when having brought under review the various formations of the Recent, Tertiary, Secondary, and Primary Periods, in which insect remains have been discovered, I shall be better able to draw general conclusions than I am in the introductory portion of the 1st paper.

I will now proceed to notice the various formations in which fossil insects have been detected, and the orders, families, and species, to which such fossils have severally been referred.

In every case British Strata and their fossils will be first described, and then those from the Continents of Europe and America.

BRITISH STRATA.

RECENT OR POST TERTIARY PERIOD.

One of the most recent deposits in this country, in which fossil insects have been detected, is that of the brick earth at Lexden, near Colchester. In a paper on the brick pit at Lexden, in the Geological Society's Journal, 1863, the Rev. O. Fisher states that he obtained a number of specimens of *Coleoptera* from this locality. These remains he submitted to Mr. T. Vernon Wollaston, F.L.S. Amongst these remains Mr. Wollaston identified several elytra of beetles, belonging to the following genera, viz.:—*Cassida*, *Curculio*, *Coccinella*, *Chrysomela*, and *Cossyphus*. Some of the specimens are referred doubtfully to *Carabidœ* and *Buprestidœ*. Mr. Wollaston stated, that with one or two exceptions, these remains could not be referred to existing British species.

In the 3rd volume of the Geological Proceedings there is a paper by Sir Charles Lyell on "The Boulder formation or drift and associated fresh-water deposits, comprising the Mud Cliffs of Eastern Norfolk." This paper contains an account of the discovery in the Mundsley deposit of the *elytra* of certain Beetles especially of the Genus *Donacia*. Mr. Curtis was of opinion that in these remains there were two species of *Donacia*, both possibly identical with existing British Insects. The same entomologist has also detected in these fossils the presence of an *Elater*, an *elytron* of one of the *Harpalidœ*; also another which he confidently refers to *Copris Lunaris*, a British Beetle.

Dr. Henry Woodward, F.R.S., has recently shown me the *elytra* of a small species of beetle, which he stated that he obtained from the Norfolk Cliffs, near Mundsley, some years ago.

FOREIGN STRATA.

The most recent deposits on the Continent of Europe in which fossil insects have been found are, according to Professor Heer, the Lignites and clays of Uznach and Dürnten, in Switzerland, which he refers to the recent or Post Tertiary period.

M. Brullé records from these deposits a *Coleopterous* insect allied to *Feronia leucopthalma*, another similar to *Callidius fennicum*, and an *Elater* referable to *Elater Œneas*.

Professor Heer has thoroughly studied the deposits of Uznach and of Dürnten, and records from them two species of *Donacia*, resembling *Donacia discolor*, and *Donacia Sericea*. He says that their *elytra* lie by hundreds in some part of the Lignite. Dr. Heer also describes a species of the genus *Hylobius (H. rugosus)* allied to *Hy obius Pineti*, but distinct; an existing species of the genus *Pterostichus (P. Niger)*, and two extinct species of *Carabidæ*, viz., *C. diluvianus* and *C. cordicollis*.

In the IX. Vol. of the "Bulletins de la Sociète Geologique de France" M. Cordier is reported to have communicated to the Geological Society an extract from a letter addressed to him from Stockholm, by M. E. Robert, in which the latter stated that he had found near Elsinore (Denmark), remains of insects, including *Lucanidæ (Cervus lougirostris)*, *Aphodius fossor*, two species of *Buprestidæ*, &c.

TERTIARY OR CAINOZOIC PERIOD.

The very few fossil insects recorded from the Tertiary formations of the United Kingdom is remarkable, especially when compared with the great number of species described from the foreign Tertiary formations. No doubt the list of species in this country will be largely increased when further investigations have been made. The insignificance of the English list may, in a great measure, be accounted for by the fact that in this country the researches and investigations of the Rev. P. B. Brodie, Professor Edward Forbes, Mr. W. R.

Brodie, Messrs. W. and H. Binfield, the Rev. O. Fisher, Captain Woodley, and others, have principally been in the Secondary Rocks, especially in the Middle and Lower Purbecks of the Upper Oolite, and in the Lias; whereas on the Continent of Europe as much attention appears to have been bestowed on the formations of the Tertiary epoch as on those of any other period; and besides, on the Continent, investigations have been carried on for a much longer period and by a far greater number of persons.

BRITISH STRATA.

MIOCENE.

In the list of fossil insects at the end of Mr. Brodie's paper on the "Distribution of Fossil Insects, &c.," I find recorded "*elytra* of two species of beetles from the Miocene formation in the neighbourhood of Antrim, Ireland." These beetles are also mentioned by Professor Judd, F.R.S., in his paper on the volcanic Rocks of Scotland.

Mr. Pengelley, F.R.S., in a paper in the Royal Society's Proceedings, states that when Professor Heer was in England he devoted a few days to the deposits of Bovey Tracey, in Devonshire, and that amongst the remains from these strata he obtained one beetle—*Buprestes Falconeri.* This insect, observes Mr. Pengelley, was the first evidence of animal life which had been obtained from this deposit.

UPPER EOCENE.

In the XI. Vol. of "Nature," for December, 1874, is a letter from a Mr. E. I. A'Court Smith recording the discovery by him, ni Gurnet Bay, Isle of Wight, "of a bed of insects, flies and gnats, and the larvæ and pupæ of the latter—the larvæ in countless thousands; also the wings in great numbers of a variety of flies, butterflies, grasshoppers; also a wing resembling that of a mole cricket; likewise two or three beetles."

A sample of this collection is at present in the possession of Dr. Henry Woodward, F.R.S., and by his courtesy I have had an opportunity of inspecting it.

MIDD

In the geological proceed describes and figures certain Creech, near Corfe, Dorset, be Middle Eocene; also *Elytra* the same formation.

Mr. J. S. Gardner, F.G. of insects at Bournemouth, i Sands; they consist of *Elytra* bees, *Diptera*, *i.e.*, small and o unknown.

LOWE

In the list at the end of "*Elytra of Coleoptera*" are rec Isle of Wight, but are not nar

Dr. Mantell, in his Geolo that Mr. Webster has observe the London Clay, near Parkhu

FOREIG

On the Continent of Euro the Tertiary Strata have be Switzerland, Radoboj in Cratia Siebengeberge on the Rhine, Bolca in Upper Italy. The re been detected in Amber from from the Amber which the Bal Prussia. It is difficult to know should be referred. By ma antediluvian. Sir Henry de l Prussian deposits of Lignite an rocks, and that its place was pr group.

I will now proceed to notice named Continental localities a have been obtained from them.

EUROPEAN STRATA.

UPPER MIOCENE

The principal deposit of this period in which insect remains have been detecetd is the great lacustrine formation of Œningen in the Valley of the Rhine, between Constance and Schaffhausen.

The Œningen Strata consist, according to Lyell, of a series of Marls and Limestones, many of them thinly laminated, and which appear to have slowly accumulated in a lake, probably fed by springs, holding carbonate of lime in solution. The organic remains have been chiefly derived from two quarries, the lower of which is about 550 feet above lake Constance, and the upper quarry is about 150 feet higher.

The insect fauna of Œningen appears to have been richer than that now inhabiting any part of Europe. From the beds of this formation 844 species have been discovered by Professor Heer, and his diligent researches had, in 1867, brought to light 5,081 specimens, viz. :—

Coleoptera	2456	specimens.
Neuroptera	882	,,
Hymenoptera	699	,,
Diptera	310	,,
Hemiptera	598	,,
Orthoptera	131	,,
Lepidoptera	5	,,
	5081	

This number of specimens comprised 844 species, viz. :—

Coleoptera	518	species.
Neuroptera	27	,,
Hymenoptera,	80	,,
Diptera ...	63	,,
Hemiptera	133	,,
Orthoptera	20	,,
Lepidoptra	3	,,
	844	

In my introductory observations I alluded to the conclusions which might be arrived at as to the climate and vegetation of a former epoch from the study of its fossil insects. I will now endeavour to explain, by reference to some of the Œningen fossils, the grounds on which such conclusions may be based.

Professor Lacordaire reminds us that insects in general, and the Coleoptera in particular, may be divided, according to the nature of their food, into two classes, viz., into *Carnivorous* species and *Herbivorous* species. The proportion which one class bears to the other varies in different countries, and according to M. Lacordaire the number of *Carnivorous* species, in proportion to the number of *Herbivorous* species, gradually decreases as we approach the Equator.

M. Oustalet, quoting Lacordaire, states that at the present day the proportion of *Carnivorus* species of Coleoptera to the total number of species of that order in the undermentioned countries is as follows, viz. :—

In the New World.		In the Old World.	
In North America	1 : 4·01	In Siberia	1 : 2·90
,, South ,,	1 : 9·59	,, Europe	1 : 3·87
,, Rio Janeiro	1 : 22·51	,, Africa	1 : 5.55

Now at Œningen the *Carnivorous* Coleoptera are to the total number of species of that order, in the proportion of 1 : 4·62, and to the *Herbivorous* species of that order, in the proportion of 1 : 3·62; that is, they are rarer in this locality than in Europe at the present day, although they are much more numerous than they are at the present day in tropical countries, especially in South America.

The fact that the *Carnivorous* species are in such a decided minority to the total number of species of the order compared with the proportion existing between the two classes at the present day, stamps the fossil fauna of Œningen with even a more southerly character than one would have expected from the flora. From this it may be safely assumed that the climate of this part of Europe during the Upper Miocene period approached much nearer to that of the Tropics than at the present day; and this assumption is materially strengthened by a consideration of the present Geographical distribution of many of the genera and species then inhabiting Œningen.

According to Dr. Heer and M. Oustalet the majority of the Œningen species belong to genera distributed at the present day over the Old and New World, and these genera are said to contain nearly two-thirds of the total number of species discovered in these strata. Heer estimates the proportion which these genera bear to the total number of genera to be 114 to 180. Amongst the other genera, according to M. Oustalet, two are not found at the present day out of Africa, two are specially American. Some are met with both in Africa, Asia, and America, particularly in the last named country.

A great number of the species of this period are allied to existing American species. Seventeen genera still inhabit the Old World ; seven of them, as well as those which are exclusively European, are still represented at the present day in the Mediterranean fauna. On the subject of the insect fauna of this locality Sir Charles Lyell observes:—"Few of the genera of Insects are extinct, but many of them imply a Geographical distribution widely different from that now obtaining in the same part of the world."

On the whole, Dr. Heer found that the results furnished by an examination of the Insect fauna of Œningen agreed with those derived from a study of the flora, although the character of the flora is more strictly American and more tropical than that of the fauna, and induced him to believe that the summer climate of Œningen was not tropical, but that the winter climate was extremely mild.

To this period (Upper Miocene) Dr. Heer refers certain strata at Parschlüg in Styria, Austria, from which he enumerates fourteen species of insects, viz :—

Coleoptera	7 species
Orthoptera	2 ,,
Neuroptera	1 ,,
Hymenoptera	2 ,,
Diptera	2 ,,
	14

The classical deposits of Senigallia, in the north-east of Italy, also belong to the Miocene period. These deposits, so famous for the quantity of animal and vegetable remains detected therein, contain, says Signor Massalongo, numerous impressions of insects. It was from these strata that Signor Procaccini-Ricci obtained a considerable number of species, which afterwards formed part of the collection of Signor Giuseppe Scarabelli di Imola.

Signor Massalongo describes two fossil larvæ of genus *Libellula*, which he states that he found by chance in splitting open some slabs of stone from this locality. He has named one species *Libellula Eurynome* and the other species *Libellula Doris.* With this exception I have failed to meet with the description of any fossil insects from Italian strata of this period.

MIDDLE MIOCENE.

To this period are referred the Marls of Radaboj in Croatia which have been productive of a great quantity of insect remains.

Professor Unger was the first author who published (in 1839) on the fossil insects of this locality a Memoir of any importance. This was followed, in 1843, by a paper by Von Charpentier (in the Acta, Acad. Leop. Carrol). Since then Professor Heer has thoroughly studied the fossil insect fauna of Radaboj, in which he has recognised a great number of tropical forms including some gigantic *Termites.*

The insects from this locality comprise the following :—

Coleoptera	42	species.
Orthoptera	13	,,
Neuroptera	20	,,
Hymenoptera	85	,,
Lepidoptera	8	,,
Diptera	83	,,
Hemiptera	61	,,
	312	

The *Coleoptera* are rare, but the Ants are represented by fifty-seven species, of one of which *(Formica Occultata)* Dr. Heer is said to have obtained 594 examples. Sir Charles Lyell observes of this locality :—"The insect fauna is very rich, and like the plants indicates a more trohical climate than do the fossils of Œningen. There are ten species of *Termites*, some of gigantic size, and large Dragon flies with speckled wings like those of the Southern States of North America; there are also grasshoppers of considerable size, and even the *Lepidoptera* are not unrepresented."

The first species of this order *(E. Atava)* was first described by Von Charpentier and referred by him to the genus *Sphinx* Dr. Heer refers it to the genus *Vanessa*, but Mr. Scudder places it in the genus *Eugonia*, "the position," he says, "dubiously assigned to it by Kirby in his "Synonymic Catalogue."

The genus to which Mr. Scudder refers this fossil is represented equally in Europe and America.

The second species, *Mylothrites Pluto*, is described by Heer and referred by him to the genus *Vanessa*. It is so described and figured by Sir Charles Lyell, who observes, "In one instance the pattern of a butterfly's wing has escaped obliteration in the marlstone of Radaboj; and when we reflect on the remoteness of the time from which it has been faithfully transmitted to us, this fact may inspire the reader with some confidence as to the reliable nature of the characters with which other insects of a more durable texture, such as the beetles, may afford for specific determination." Mr. W. H. Edwards, of Western Virginia, in his work on "American butterflies," expresses an opinion that this species ought to have been referred to the genus *Argynnis*. I have carefully examined the species of the genus which Mr. Edwards considers the nearest living representative of the fossil species *Pluto*, in the collection of the British Museum, but fail to trace in it any but a very superficial resemblance to the latter, of which it is double the size. My friend, Mr. Butler, refers it to the genus *Junonia*, but Mr. Scudder states that the new drawing of the fossil which he has received through his friend, Herr Brunner von Wattenwyl, leaves little doubt that the insect is a *Pierid*, and belongs to some genera intermediate between *Mylothris* and *Hebomoia*, and he desribes and figures the insect as *Mylothrites Pluto.* The remains of this insect are particularly interesting as belonging to an extinct genus whose nearest living representatives, according to Scudder, are to be looked for in the genera *Mylothris* and *Hebomoia*, the former of which finds its highest development in Africa, while the latter is confined to the Indo-Malayan and Austro-Maylayan regions.

The remains of the third and last species, *Pontia Freyeri* are also described by Heer and Scudder. The genus is a modern one which is well represented by existing species, especially in the Old World.

LOWER MIOCENE.

From strata referable to the lower Molasse of Switzerland, Dr. Heer enumerates thirty-three species of insects, viz. :—

Coleoptera	26 species.
Neuroptera	2 ,,
Hymenoptera	1 ,,
Diptera	1 ,,
Hemiptera	3 ,,
	33

The lignites called brown coal in Germany belong for the most part to this period, and are often rich in insect remains.

The lignites of Rott in Siebengeberge, near Bonn, are the best known. From these lignites about twenty-nine species of insects had been recorded by the year 1856, according to Bronn, Germar, and Giebel. These twenty-nine species were distributed amongst the undermentioned order as follows, viz :—

Coleoptera	18 species.
Hymenoptera	2 ,,
Lepidoptera	1 ,,
Diptera	5 ,,
Orthoptera	1 ,,
Hemiptera	2 ,,
	29

In 1859 Carl von Heyden described twenty-one additional species from this locality, viz :—

Coleoptera	12 species.
Hemiptera	1 ,,
Hymenoptera	2 ,,
Lepidoptera	1 ,,
Diptera	5 ,,
	21

The subsequent investigations of Prof. Heer, Dr. Hagen, and Herren Carl von Heyden and Lucas von Heyden have raised the number of species from Siebengeberge to one hundred and eighty, viz :—

Coleoptera	92 species.
Orthoptera	1 ,,
Neuroptera	12 ,,
Hymenoptera	3 ,,
Lepidoptera	2 ,,
Hemiptera	5 ,,
Diptera	65 ,,
	180

It will be noticed that only two Lepidopterous insects are enumerated from this locality. One of them is a butterfly described by Carl Von Heyden as *Vanessa Vetula.* Of this fossil Mr. E. Scudder observes, "The single fossil represented by Von Heyden, under the name of *Vanessa Vetula,* is preserved on a greasy, dark brown, thin, and exceedingly fragile sheet of brown coal, and is likely to become so affected by weathering as to be almost or quite undistinguishable in the course of time." Mr. Scudder further observes that *Vanessa Vetüla* is "the only butterfly yet found from the horizon of the Aquitanian or Lower Miocene and that it is closely related to *Thanaos,* a genus belonging to the North Temperate Zones of both Hemispheres. The genera adjacent to *Thanaos* are said to be purely American, although tropical or sub-tropical, and therefore this species looks towards sub-tropical North America for its relatives of the present day.

In the 10th vol. of Meyer and Dunker's Paleontographica (1862), thirty-one further species of insects are described from the lignites or brown coal of the Rhine and the Rhone, viz :—

Coleoptera	20	species.
Orthoptera	1	,,
Hymenoptera	3	,,
Neuroptera	1	,,
Lepidoptera	1	,,
Diptera	5	,,
	31	

Amongst other deposits of brown coal in which fossil insects have been detected, may be mentioned those of Von Sieblos, Stöschen, and Salzhausen, from which Dr. Hagen, Carl von Heyden, and Lucas von Heyden describe about 34 species, including some gigantic *Neuroptera.*

The total number of species obtained from the lignites of brown coal amounted by the year 1863, according to Dr. Hagen, to 103.

Since that date 142 further species have been obtained from the same deposits, giving us up to the year 1870 a total of 245 species distributed amongst the undermentioned orders as follows:—

Coleoptera	126	species.
Orthoptera	6	,,
Neuroptera	16	,,
Hymenoptera	8	,,
Lepidoptera	3	,,
Hemiptera	10	,,
Diptera	76	,,
	245	

During the last seven years numerous additions may have been made to the list, but if they have, I have been unable to find any record of them.

To this period (Lower Miocene) are referred the fresh-water formations of Auvergne in Central France. These formations are in some places, according to Lyell, partly composed of that remarkable form of limestone, called "indusial," from the cases or Indusiæ of the Caddis worms or larvæ of *Phryganea,* great heaps of which have been encrusted as they lay by carbonate of lime, and formed into a hard travertin. These Caddis worms are abundant at the bottom of fresh-water streams and lakes, and many of the fresh water limestones of this locality are, according to Dr. Mantell, almost wholly composed of these cases, cemented together by Calcareo Siliceous matter into stone, which is much employed for building purposes.

"If we consider," says Mr. Scrope, "that strata of five or six feet in thickness almost entirely composed of these tubes (cases) once extended over a district presenting a surface of many hundred square miles, we may have some idea of the countless myriads of minute beings which lived and died within the bosom of that ancient lake."

Professor Pictet seems to entertain some doubt as to whether the tubes or cases before mentioned, of which the indusial limestone is in a great measure composed, were formed by larvæ of *Phryganea* or Caddis worms. He says these tubes are much thicker than those formed by *Phryganea;* the internal cavity is much smaller, and they are besides much longer, and more resemble the tubes formed by certain *Annelida.*

M. Oustalet has recently made a special study of the fossil insect fauna of Auvergne, and has published on the subject a most important memoir, only equalled, in my opinion, in value by Professor Heer's great work on the insect fauna of Œningen and Radoboj.

The places in this part of France in which the majority of these fossils have been discovered are Corent, Menat, and St. Gerand le Puy. From these localities M. Oustalet states that he has studied not less than one hundred specimens in the collections of M. M. Lecoq and Fouilhoux, and the Museum of Natural History at Paris, or collected by himself during his travels in Auvergne.

These specimens comprise some forty-nine species distributed amongst the following orders in the following manner, viz. :—

Coleoptera	10	species.
Orthoptera	1	,,
Neuroptera	5	,,
Hymenoptera	2	,,
Diptera	30	,,
Lepidoptera	1	,,
	49	

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So far as I can ascertain, the most recent discovery of fossil insects in this part of France has been made by M. Ch. Brongniart, who, in the "Bulletins de la Societe Geologique de France" for last year (1876), describes a new species of a Dipterous insect, which he has referred to the genus *Protomyia* and named *P. Oustaleti* in recognition of the very important contributions to our knowledge of the fossil insect fauna, of France, made by M. Oustalet.

The genus *Protomyia*, of Heer, observes M. Brongniart, contains no living representatives, although it wasnumerously represented during the Tertiary period, nearly 40 species referable to it having been described by Heer, Von Heyden, and Oustalet.

According to M. Brongniart, this new species was discovered in the calcareous Marl of the inferior Miocene formation of Chadrat in Auvergne. It differs from all previously described species in the distribution of the nervures, and appears most closely allied to *P. Joannis* and *P. Bucklandi.*

UPPER EOCENE.

Nowhere in the Continental formations of this period, with the exception of Œningen, have fossil insects been discovered in greater abundance than at Aix, in Provence. The town of Aix is situated in the lowest part of a deep valley, the immediate flanks of which are composed of a thick fresh-water formation lying unconformably upon strata of Jura Limestone. The Fresh-water series consists of white and grey calcareous marls, calcareo siliceous grits, and beds of gypsum.

M. Marcel de Serres was the first to make known to the scientific world the occurrence of insects in these gypseous marls.

In his "Geognosie des terrains tertiaires," he enumerates about eighty genera from this locality, comprising the following viz.:—

Coleoptera	20	**genera.**
Orthoptera	6	,,
Hemiptera	14	,,
Neuroptera	2	,,
Hymenoptera	9	,,
Lepidoptera	4	,,
Diptera	20	,,
	75	

The insects included in these genera were said by Marcel de Serres, to be all of European forms, and to be mostly referable to species still existing.

A number of insects from this locality (including some 45 species, collected by Murchison and Lyell) were also described by Mr. Curtis, in 1829. They consisted principally of *Diptera*, *Hemiptera*, and *Coleoptera*, with a few *Hymenoptera*, and one *Lepidopterous* insect. According to Curtis, several of the beetles had their wings extended beyond the elytra, as if they had been flying and had dropped, and a *Chrysomela* had the elytra expanded, from which it would appear that it had fallen upon the water and been drowned. Other insects appear to have been imbedded whilst in repose or when walking.

Some eight years later, when Bronn published his "Lethœa Geognostica," a great number of other genera had been discovered in this locality, for in the second volume of the last named work the following are enumerated :—

Coleoptera	33	genera.
Orthoptera	6	,,
Hymenoptera	9	,,
Neuroptera	2	,,
Hemiptera	17	,,
Diptera	22	,,

besides the four *Lepidoptera* mentioned by Marcel de Serres.

By the year 1844, the researches and investigations of the Rev. F. W. Hope in this locality, had raised the number of genera enumerated by Marcel de Serres, Curtis, and Bronn, to one hundred and thirteen, for twenty of which we are indebted to Mr. Hope.

For some years after the date of Mr. Hope's paper the fossil insects of Provence, which had for a time attracted a considerable amount of attention from geologists and Paleontologists, remained unnoticed. At length, in 1851, Professor Heer commenced to study them. In addition to the specimens he himself obtained during his travels in Provence, he was enabled to study those in the collection of M. Blanchet, of Lausanne, and those collected by Sir Roderick Murchison, in 1829.

M. Oustalet observes that from these fossils, and a comparison of their species with those found in the strata of Œningen and Radoboj, combined with the study of the fossil flora of these strata, and those of other Swiss and German localities, Professor Heer was enabled to form most interesting conclusions on the climate and conditions of life prevailing at that era of the Tertiary period in different countries of central Europe.

Of the fossil species from the marls of Aix, Dr. Heer observes that nine have been found at Radoboj, and four at Œningen, that is to say, that twice as many species are found at Radoboj in common with Aix than at Œningen, although this last locality is much nearer Provence, and possesses a much richer fauna, and consequently offers many more points of comparison. Even those species which are not common to both Radoboj and Aix, but are confined to the last locality, are most intimately connected with those of the former.

At the time at which Dr. Heer was writing, the exact geological position of the gypseous marls of Aix had not been determined, but according to M. Oustalet they were regarded as contemporary with those of Montmartre belonging to the Ligurian or upper Eocene.

From his study of the fossil insects of these marls Dr. Heer was of opinion that their geological position should have been somewhat higher up nearer the marls of Radoboj in the Miocene formation. Dr. Heer's conclusions, derived almost solely from a study of the fossil insects of the district, have since been to a great extent confirmed by the majority of geologists who have subsequently studied this formation, and although the strata have not been referred to the same periods as the marls of Radoboj, they have been placed higher up, near to them at the base of the Miocene period, almost on a level with the sandstone grit of Fontainebleau.

M. Marcel de Serres stated, as I have before observed, that the majority of the fossil insects of Aix belonged to existing

European forms, and he concluded from this that the geological conditions of Aix during the upper Eocene period were similar to those of the present day.

This opinion of Marcel de Serres, observes M. Oustalet, is far from being in all respects confirmed by recent observations, for whilst admitting that the fossil fauna of Provence contain a number of types, if not identical, at least closely allied to those now inhabiting the Mediterranean basin, it also contains several forms which at the present day are only represented in the South of Africa, in Asia, and America.

According to the researches of Count Saporta, the fossil flora of the period has a more southerly character than even the fauna. From these investigations of the fauna and flora of the period we may reasonably presume that the climate of Aix, at the end of the Eocene and commencement of the Miocene period, more nearly approached that of the tropics than at the present day.

One of the most remarkable facts connected with the Aix formations, and which has perhaps served to render them more interesting to entomologists than any others from which fossil insects have been obtained, is that of the *nine* well authenticated fossil butterflies from the European Tertiary formations, *five* of them have been found here. Of these five species the first discovered and best known to the world at large is *Neorinopis Sepulta*, the earliest notice of which is given by Marcel de Serres in the "Annales des Sciences Naturelles" (1828). Mr. Scudder, who has figured and described the insect, states that the earliest definite mention of it is given by Duponchel in the "Bulletin de la Société Entomologique de France" in the following words, "M. Duponchel entretient en suite la Société d'un fait extraordinaire et peut-être entièrement nouveau dans les annales de la Science, c'est l'existence d'une impression très remarquable de Lepidoptere fossile, qui a été trouvée dans une plâtrière des environs d'Aix, et acquise par M. de Saporta, &c."

The species was subsequently described and figured by Dr. Boisduval. Mr. Butler has referred it to the *Satyridæ*, and has described and figured the insect in his "Lepidoptera Exotica."

The second butterfly from these formations is described for the first time by Mr. Scudder as *Lethites Reynesii*. It does not, in his opinion, belong to any existing European genus, and he mentions *Maniola Hermione* as its nearest ally among living European types. This fossil was found by Mr. Scudder in the Museum at Marseilles, and named by him after Dr. Reynes, director of that establishment. It appears to have been previously overlooked.

The third butterfly from Aix is described and figured by Scudder as *Coliates Proserpina*. It is in the collection of Count Saporta. It appears to have been discovered in the strata immediately beneath the calcareous marls of the gypsum quarries, and is, therefore, the oldest butterfly from the Tertiary formations.

The fourth insect of this order from these deposits is described by Professor Heer as "*Thaites Ruminiana*," who observes of it, "closely allied to the genus *Thais*, which belongs to the Mediterranean fauna." It is in the collection of Professor Heer, and has been also described and figured by Mr. Scudder.

The remains of the fifth and last butterfly from the tertiaries of Aix, or, indeed, from any tertiary formation, consists of a single forewing, which Mr. Scudder refers to some species of a genus belonging to the *Astyci*. Mr. Scudder describes the species as *Pamphiletes Abdita*. The remains are in the Marseilles Museum.

It will be noticed that the remains of all the fossil butterflies at present described have been found at Radoboj, Rott, and Aix, *all* belonging to the tertiary formations; that the remains of three species belong to the *Mayencian*, or lower portion of the Middle Miocene, the remains of one species to the lignite beds of Rott, belonging to the *Aquitanian* or upper part of the lower Miocene, and the remains of the other five species from the calcareous marls (or strata immediately below the same) of the gypsum quarries of the *Ligurian*, belonging to the Upper Eocene formation. It is, as Mr. Scudder observes, rather extraordinary that the Upper Miocene beds of Œningen which, if we except the amber, have furnished almost more insects than *all* the other formations of the world together, and which are more recent than any of those in which butterflies have been found, have yielded the remains of only one species of *Lepidoptera*, and none whatever of butterflies.

The most recent investigations of the geological strata of this district and their fossil insects have been made by M. Oustalet, who, in 1874, published the result of his investigations in the second part of his "Recherches sur les Insectes fossiles des Terrains Tertiares de la France." In this most important work (a copy of which I have had the honour of receiving from the Author) M. Oustalet has expressed his intention of doing for the insects of Provence what Dr. Heer has done for those of Œningen. Some idea of the magnitude of the labours which M. Oustalet has undertaken may be formed from the fact that although the work above mentioned contains some 347 pages, exclusive of 6 plates, the *Coleoptera* only are included in it. Of the insects of this order upwards of 80 species referable to 13 families are described and figured.

The *Carabidæ* are represented by 11 species, the *Staphylinidæ* by 19 species, the *Curculionidæ* by 33 species, and the *Chrysomelidæ* by 7 species.

With the exception of the learned Zurich Professor, no other Paleontologist has produced any works on this branch of science of greater importance than M. Oustalet.

MIDDLE EOCENE.

To this period Sir Charles Lyell refers the marls and limestones of Monte Bolca, near Verona, in Italy. Associated with these marls and limestones are beds containing lignite and shale, which have been described by Professor Unger and Signor

Massalongo, and referred by them to the same period. M. Marcell de Serres alludes to the discovery at Monte Bolca, by Scheuchzer, of some *Neuropterous* insects of the genus *Libellula*.

Scheuchzer's notice of these insects is also alluded to by Signor Massalongo, who in 1856 described and figured 7 fossil insects from this locality referable to the following orders :—

Coleoptera	2	species.
Orthoptera	1	,,
Neuroptera	2	,,
Diptera, ...	2	,,
	7	

Although so few insects have been found in these deposits they have been for centuries celebrated for their fossils, especially *Ichthyolites*.

AMERICAN STRATA.

RECENT OR POST TERTIARY PERIOD.

I am indebted to Mr. R. M. Lachlan, F.R.S., for an extract from a paper (in the 5th vol. of the "Transactions of the American Entomological Society") by Dr. G. H. Horn on certain *Coleopterous* remains discovered in cave deposits (belonging to the Port Pliocene period) at Port Kennedy, Pensylvania. From these remains Dr. Horn has identified some 10 species of *Coleoptera*.

TERTIARY PERIOD.

The earliest discoveries of fossil insect remains from the American Tertiary formations appear to have been made several years ago by Professor Denton in shales in Colorado, near the junction of the Green and White Rivers. They are said to have been found in two distinct localities sixty miles apart, the specimens in one place differing from those of another, not only specifically but in their general character. Subsequent investigations in other parts of the same region have since been made by Mr. F. C. A. Richardson and also by Dr. Hayden. In a letter to the Editors of the *American Naturalist*, Mr. Richardson says: "I discovered and collected the fossil insects on the Green River, in Wyoming Territory, on the line of the Union Pacific Railroad, some 40 miles this side (east) Salt Lake City, or, to be more precise, the locality is 5 miles west of Green River City, and on the Railroad Track. The shale or portion of shale in which the insects were found runs in a circle from the N.E. to the S.W., as if on the border of a small lake. I also noticed that the fish are not in regular order, as the insects which cover a space about 2 feet wide and form a ring or belt around the lake."

On the subject of the insects discovered by Mr. Richardson, Mr. Scudder says: "About 100 slabs, mostly of very small size, were brought away; these contain at least 175 specimens, including in that number all the reverses. Of these specimens, 35 cannot be referred with certainty to any subordinate group, since they consist merely of abdominal segments, or blurred and distorted fragments, the affinities of which can only be rudely surmised. The remainder are referable to nearly 40 species belonging to the following groups, mainly arranged in the order of numerical superiority:—

Diptera	66	specimens—	13	species.
Coleoptera	52	,,	—12	,,
Hymenoptera	5	,,	— 3	,,
Hemiptera	4	,,	— 2	,,
Orthoptera	4	,,	— 2	,,
Neuroptera	2	,,	— 2	,,

Quite recently Mr. Scudder has published a description of two species of *Orthopterous* insects from the Rocky Mountain Tertiaries. The first species Mr. Scudder has described as *Homœogamia ventriosus* and the latter as *Labidura tertiaria*.

Since the date of the last mentioned paper, Mr. Scudder has published detailed descriptions of 31 species of *Coleoptera*, most of which were included in those before referred to as having been found by Professor Denton and Mr. Richardson, and a few others of which were found by Mr. Mead or by members of the United States Geol. Survey.

"In this paper," said Mr. Scudder, "are made known the first fossil *Coleoptera* from the Tertiaries of the United States;

indeed, if we except some doubtful remains in the red sandstone of the Connecticut Valley, the first distinctively American *Coleoptera* from any formation. Two beetles have been figured by Heer from the Miocene of Northern Greenland, and these are all that have yet been described from the New World."

These valuable contributions to our knowledge of the fossil insects of the American Tertiaries were alluded to by Professor Westwood in his anniversary address to the Entomological Society of London on the 7th February last, who also stated that Mr. Scudder had published "the descriptions of several fossil species of *Thripsidæ* from the North American Tertiaries, including two new genera, *Lithadothrips* and *Paleothrips*.

Mr. Scudder has very recently described several species of insects obtained by Mr. G. M. Dawson from tertiary beds at Quesnel, British Columbia. In addition to fragmentary indeterminate remains, there are some 24 species distributed among the undermentioned orders, as follows :—

Coleoptera...	1	species.
Neuroptera	1	,,
Hymenoptera	7	,,
Hemiptera...	1	,,
Diptera	14	,,
	24	

AMBER.

Before closing this paper I must say a few words about amber and the insects which have been detected in it.

Nowhere have fossil insects been found in greater numbers or in a more beautiful state of preservation than in this "resinous and bitumenous substance." By most geologists amber is considered as antediluvian, but its origin has been the subject of much dispute. Some ancient writers attributed it to ants, and some considered it to be of mineral origin. It is now considered by all authorities to be of vegetable origin, and to have been formed from the resin which distilled from certain species of fir trees of the Tertiary epoch, whose fossilized trunks are said to form the lignite in which it is frequently obtained. Dr. Berendt and

M. Goeppert are said to have disco
Amber is the product of a fir tree,
extinct. In some cases the leav
found in amber, and although, a
appear to differ from all known
justified in ascribing them to the g

On this subject the Rev. F.
letter lately received from Dr. Bere
anotomico-microscopical examinatio
a doubt that the amber was a *Pinus*
be now known, and that *Pinus Bals*
in appearance."

The period during which this
supposed to have been about the co
epoch. The lignites or Brown Coal
the Chalk and inferior to the Tertia
sands of Germany.

Amber is said to be occasionally
East Coasts of England along with
from the bed of the sea may be was
there are regular mines of it. It is
of Sicily and the Adriatic Sea and a
Brown Coal in Germany, and is occa
France. Dr. Berendt states that h
geographical focus of the amber wood
Baltic."

The insects at present detected in
species extra European, many of th
climes, while some approach South
They do not appear related to any exis
fore probably extinct, and this seems t
Jussieu, De Jean, Hope, Dr. Leach
subject the Rev. F. W. Hope says,
insects discovered in amber exhibit

existing species, and can be satisfactorily classed under published genera. That any of those which are found in amber are *identical* with existing species I do not believe, for out of many hundred specimens, nay, I may say thousands, which have fallen under my notice, none have yet induced me to change my opinion that they are otherwise than of the Tertiary period."

The number of species of the different orders of insects discovered in amber, and according to the list at the end of Mr. Hope's paper on "Succinic Insects" and the investigations of Sendelius, Berendt, Germar, Bronn, Gravenborst, Ehrenberg, Pictet, and other writers on the subject, is as follows :—

Of the	Coleoptera,	about	160	species.
,,	Hemoptera,	,,	11	,,
,,	Neuroptera,	,,	10	,,
,,	Hymenoptera,	,,	25	,,
,,	Orthoptera,	,,	12	,,
,,	Hemiptera,	,,	15	,,
,,	Lepidoptera,	,,	10	,,
,,	Diptera,	,,	22	,,

Mr. Hope also gives a list of species from Copal and Auimé, which includes :—

Coleoptera	9	species.
Hymenoptera	2	,,
Hemiptera	1	,,
	12	

In his "Fauna der Vorwelt," Dr. Giebel enumerates 318 species from Amber, viz. :—

Coleoptera	106	species.
Hymenoptera	14	,,
Lepidoptera	3	,,
Diptera	141	,,
Neuroptera	28	,,
Orthoptera	4	,,
Hemiptera	22	,,
	318	

One of the best accounts of the history and origin of amber is given by Professor Zaddach of Königsberg, an abstract of which in English, appeared in the *Quarterly Journal of Science*, for April, 1868; and since then the Rev. P. B. Brodie has written an

admirable paper on the subject
contains, which was read at the
shire Naturalists' Field Club, in

The lecture was attentiv
applauded at the close, and, at th
cordial vote of thanks was awar
The very patient attention the m
that the research which the lec
thoroughly appreciated, and the
at what he had revealed.—Mr. T.
secretaries) also expressed his
matters which had been brough
Goss having announced that the le
first of a series of three, which he
they were delivered, Mr. B. LOM
the series would constitute a most
The conversation was continued
Dowsett.

MARCH 2

MICROSCOPICAL

This being a general evening
under microscopes by Mr. G. D.
W. Wonfor, one of the hon. secs.
D. Michael. Mr. Sawyer exhibit
section of stellate tissue, eggs and
of the diamond beetle; Mr. Wonf
lobster insect found in melon pits,
Mr. Aylen, a shaving of the horn
Michael, coralines in fluid, with ext
in chain. At a meeting of the Co
previous to the microscopical meetin
prize of five guineas for the best

following orders, made by residents in Brighton, Hove, and Preston :—Ranunculaceæ, Papaveraceæ, Cruciferæ, Violaceæ, Polygalaceæ, and Caryophyllaceæ.

APRIL 12TH.

ORDINARY MEETING.—DR. CORFE ON THE STRUCTURE AND DINETICAL CURRENTS OF SPONGELETS AND FIBRILS OF ROOTS.

The object of his communication to the Society was to give publicity to a series of microscopical appearances on the structure and dinetical currents of spongelets and fibrils of roots, which, whilst they confirm the researches of eminent phytologists on cyclosis in leaves, stems, and hairs, appear to have escaped attention in this field of life-germs.

If it is asked, "What inscrutable power presides over the intricate machinery of vegetable and animal life, of elaboration, digestion, and assimilation, whether it be in the tiny weed we tread upon or the colossal form of an elephant?" we reply unhesitatingly, electrical force—a force which man has recently enlisted in his service and has so utilised that he conveys his thoughts in a few seconds to his fellow-men through a space as wide apart as the Arctic and Antarctic seas. He would remind them that the surface of the globe and the bowels of the earth afford two mighty currents of this force; the one is moving *from* us on the eastern side and is at right angles to the magnetic meridian, or parallel to the equator, and corresponds to the negative pole of an electro-magnetic battery; the other, on the Western side, is moving *towards* us, and answers to the positive pole, and is parallel to the straight line which joins the poles. Every substance above, upon, and below the earth's surface contributes its quota to these currents, some so highly that they are styled "Paramagnetic," by Farady; others, being feeble, he called "Diamagnetic," and thus the bosom of our globe is one stupendous and infinite reservoir of electrical fluid, oxygen in gases, iron in metals standing highest in the former, hydrogen and potassium in the latter.

In contemplating the whole cycle of animal life, they were at once met by wheels within wheels; thus they had the vascular cycle within the skull of a mammal; again, that within the liver; and another within the kidney—each one differing from and independent of the other.

Without further preface he would direct their attention to the dominant cycle and mainspring of the whole fabric—the venous blood, ere it reaches the pulmonary heart. What was it they found? A black, mephitic, used-up mass, not less injurious to health than the poisonous "choke damp', of a coal mine. This fluid must be broken up, and for that end it was intimately dispersed over another, or sub-dominant cycle, the air-receiving cells, of the extent of whose surface they might form some idea if they could lay down a delicate scarlet thread at the Town Hall gates, and carry it over the English Channel to Montpellièr, or two hundred and eighty miles. This re-vitalized fluid returned to the central hydraulic engine, and from there it was chased through the whole arterial frame, whose area was computed to measure double this length of space.

Look at the cycle of alimentation. Here, again, destruction precedes reorganization. Food was torn to shreds, triturated, irolled, ground, warmed, moistened, and soaked with kaloid juice, and thus chemically dissolved, altered, and at length swallowed, thence to be subject to another circular churning, alternately with a steady longitudinal kneading before it can pass the gatekeeper of that mysterious vital laboratory, the stomach, into the intestinal canal. What did they behold after the mass had received some finishing touches from those factors of special juices—"bile and pancreatine?" "White blood!" travelling upward against the law of gravitation, to supply the mighty engine of the dominant cycle with raw material for its work, which was destined to turn out its 150 ozs. of blood per minute, hour after hour, day after day, down to the hoar hairs of an octogenarian life. Thus—

"From dearth to plenty, and from death to life,
Is Nature's progress when she lectures man
In heavenly truth, evincing as she makes
The grand transition, that their lives and works
A soul in all things, and that soul is God."
(Winter Walk at Noon.)

No department of physiology affords so great an insight into the process of cell formation as the study of the growth of spongelets and root fibrils. Here they caught a glimpse of the minutest speck of protoplasm, passing into the formation of a primitive cell-wall and cavity; further on they recognised colour in it; chlorophyl was seen in cells five inches distant from the axis of the stem; then above this region, granules of gum and starch appear. A living plant in its rootlets, and a living animal in its digestive apparatus, each represents a chemical laboratory, in which compound bodies were analysed or separated into their component parts, and recompounded into other substances distinguished as vegetable or animal products. The proteine bases might be set forth by remembering the German adverb "Noch" (yet still more). Give to nature this brief alphabet, and four other metalloids, the initials of which form our English word "lips," and she would bring into being an infinity of nitrates, oxides, carbonates, and hydrates of lime—iron, phosphorus (or potash) and soda (or sulphur). These four proteine elements were wholly engaged in working up the compounds of binary and ternary substances, as starch, gum, glucose; but when a quarternary body is demanded, she calls into the service a metalloid, and produces gluten, albumen, either with sulphur or phosphorus, &c. This tiny, yet stupendous and ever busy world of eddies and of currents under ground might be better exemplified by putting before them the effect which was produced by the clashing together of two elements forming water. If one pound of hydrogen, a diamagnetic element, was forced into union with eight pounds of the paramagnetic element, oxygen, the mechanical

value, according to **Faraday**, v
millions of pounds one foot hi
temperature, and the same pl
degree of heat (centigrade) was
by the chemical union of a pounc
two-thirds of oxygen. Apply thi
within radiculer cell walls, and t
was easily grasped and explained.

The mural claws of the co
and in function similar to radic
between the floral axes. Th
those branches which hang loo
with water, they would obser
their cul-de-sacs by endosmose,
cells lying around the bases
suckers (he might call them) v
starchy, gummy, and mineral gra
was analagous to the vasiform stru
out end to end, and agreeably t
were seen to contract also at certa
The radicles of "sow thistle," and a
Acris," presented globules of a tr
one another, *per saltem*, from *righ*
the field, whilst much smaller glo
objects were travelling, *pari-passu*,
tube, the former only appearing t
and tubules. In another rootlet a
riotous dinetic action, as it struck hi
roitiferæ, who were leaping and da
around their compartment. In a th
current was most distinct, and co
effect of endosmosis; no similar m
body of the object. The leaf cell
known to communicate, by the fact t
one cell to another, and even formed

this instance, these animalcules might probably break up surrounding fibrils for the ulterior processes of organization. The radicles of the sow thistle and onion were severally found to exhibit a beautiful dinesis, especially the latter, where the retiformed cells, spiral tubules, dots of light and darker shaded granules of chlerophyl, with other globules, formed one of the most lovely pictures he had ever witnessed.

Life, beauty, elegance, and work were simultaneously displayed on the field. The day after this examination, chlorophyl gobules in abundance were formed at the extremity of the tap root of the thistle, measuring five inches from end to the throat of the stem.

The value of distinguishing these primitive movements by the special term "dinesis" is this, that whereas in the ordinary progression of latex, whether within the laticeferous vessels or in those of the liber, the flow was regular, and uninterrupted from the apex of the whole plant to the base, whether they examine a leaf or a stem; and so long as this movement was uninfluenced by injury to the vessels there was no appearance of a check to this osciliation. The reason was obvious. The uniformly steady elimination of oxygen, the fixation of carbon, and general exhalation of aqueous vapour, are processes over which solar heat and light maintain calm, equal, and unlimited power. But the case was otherwise in radical circulation. Nutriment had to be sought for and selected by the spongioles; decomposition of mineral substances by effete gases was performed, and solutions of these bodies must be accomplished, excretion of used up products take place, molecules of starch and gum worked up into "raw material"—all these important functions were simultaneously going on within the cell walls of the rootlets. So that whilst the microscopical field was calm for a few seconds, the eye was startled with a sudden leap of the current, here and there, an increased whirl of the whole, then a halt, and again a movement forward, accompanied ever and anon with a smart or a slight contraction of the cell itself. These vital actions concurring occasion eddying of the fluid during osmosis, which were not seen in the study of the currents through leaves, hence the objection to the term cyclosis as applied to this radiculer eddy. In the attempt he had made to exhibit some facts in cytogenesis (cell formation), as observed in spongelets, the life history of the individual cell must form the basis of their study. But as in this research they found great diversities of operations, so also varied opinions and explanations on the subject had been given, which have tended to obscure the mode by which nature carried on her work beneath their feet. The truth was, that in the vegetable life, as in the animal, the number of dissimilar tissues and the differences between them were as decided as the shape of pollen. Endowments peculiar to certain plants, as for example, the lofty and woody elm, must necessarily be connected with " organs," that was with instrumental structures, which were fitted to develop constituents in the future tree, but which were uncalled for in the growth of the tiny weed, or elegant pansy flower. The great desideratum was a classification of vegetable life-forms, based on the several modes by which that life begins and is carried on in the cell walls of the spongelets of cryptogams, endogens, and exogens, whether, in the first division, the parent cell discharges young cells, as was the case with " Achlya prolifera ;" and whether the gemmiparous reproduction of zoophites is typified in the growth of the rootlet of a monocotyledon ; and lastly, do the higher form of fissiparous or cell division in exogens bear an analogy to the reproduction of infusorial animalcules ? The philosopical botanist of the day felt that the vast forms of which the vegetable kingdom was composed rested upon a very unsatisfactory foundation, since, as Dr. Carpenter truly remarks, " there is no one tribe of plants whose internal structure, and the history of whose development, have been sufficiently studied to afford the requisite data for a truly scientific arrangement." Let him, therefore, urge upon the members of this Society to pursue the study of the cytogenesis in spongelets and fibrils as a relaxation in the intervals of the toilsome avocations of daily life, which he was convinced would afford an abundant harvest of novelties, and might tend to have further scientific value to the present obscure system of botanical classification. Before them were specimens of the interesting facts connected with cell formatien in spongioles.

The Dialyser was a thin membrane, a gross representative of the delicate vegetable cell wall; the contents of the tubes indicated the several gummy, saccharine or starchy fluids within these cells, and the glasses beneath, with their varied mixtures, set forth the food which nature or art supply to the spongelets and fibres. In conclusion, what finite mind could do more than hover around the inscrutable cycle of human embryonic life with its cells and its cells. By what means should one set of vessels lay down the rudiments of bone, another those of muscle, another the elements of a future brain, to be the seat of an intellectual Milton or a Shakespeare? How were these deposited so miraculously in the exact spot where they would afterwards be required, and this, too, months ere they would be called into use. Anon, 270 suns have gone down on this cycle. The hour was come when irresistible refley force was roused, innate fœtal movements coalesce, and ere another dawn arises upon this world within a world, a new and independent life is called forth from that original cryptic cell to add another illustration of nature's handiwork that she moves in a glorious series of circles of wheels within wheels.

The PRESIDENT (Mr. G. D. Sawyer) moved a vote of thanks to Dr. Corfe, who he said in the reading of his paper had brought many interesting facts together. He was sure that they would join with him in thanking that gentleman for his efforts and for his perseverance in reading his paper, notwithstanding his great difficulty in suffering from a heavy cold.

In the course of a conversation which followed, it was suggested by Mr. Wonfor that the subject should be again brought forward at their next microscopical meeting.

APRIL 19TH.

MICROSCOPICAL MEETING.—ROTATION OF CELL CONTENTS.

Mr. **WONFOR** reminded the members that, at the last meeting, it was understood that, at this one, members should bring forward any slides which should illustrate Dr. Corfe's paper on "Dinetical currents in radicles of roots and their analogues." At this time of the year, there were some three plants obtainable, in which cyclosis, or rotation of cell contents, erroneously called circulation, might be seen to lesser or greater advantage, namely, the American pond weed, *anacharis*, the *valisneria*, and *nitella*.

DR. CORFE asked if it had occurred to Mr. Wonfor what was the motive powers of these actions—not in the stems, or leaves, or hairs, but in the roots.

Mr. **WONFOR** remarked that they had only heard Dr. Corfe's explanation; they had not had the opportunity of making observations for themselves. It would, therefore, be premature to conclude what might be the causes, whatever they might imagine.

In the course of continued conversation on the subject,

Dr. **CORFE** wondered why railway companies encouraged vegetation by throwing up embankments, such as that near Hassock's Gate, a spot which had given more trouble to the London, Brighton, and South Coast Railway Company than the whole line, in consequence of the sinking of the ground.

Mr. **WONFOR** remarked that this was a striking instance of the fact that while they could not get vegetable life in unmoved chalk, yet if it were moved they would get annuals, then biennials, and then perennials.

Soon after the conversation gave place to microscopic investigation.

Mr. **Wonfor** exhibited the rotation of cell contents in two of the plants he had named; and the Rev. J. **Beecheno**, sections of foraminiferæ from St. Vincent, Zanzibar, the Gulf Stream, and other parts.

MAY 10TH.

ORDINARY MEETING.—MAJOR HALLETT, F.L.S., ON THE LAW OF THE DEVELOPMENT OF CEREALS.

I have the honour to appear before you, in compliance with a request from your respected President, that I should read a paper upon the above subject, which I will endeavour to treat in the simplest manner possible. Opinions have differed as to the number of distinct species, but taking wheat as an illustration, no matter what the number favoured, the opinion has been in the main, if not altogether, founded upon such distinction as the following:—

1 Winter and Spring.
2 Bearded and beardless.
3 White, red, or yellow grain.
4 Smooth and rough-chaffed ears.
5 Composite and simple ears.

At the end of the year 1860, Colonel Le Couteur (afterwards Sir John Le Couteur), of Jersey, sent me a copy of his well-known work on Wheat, published in 1826, and also two ears of his Belle Vue Talavera wheat grown in 1860, asking me to experiment upon them upon my system, but warning me not to plant any of the grains in the autumn, as it was a "Spring" wheat and could not endure the winter. Probably nowhere else in the world could such a verified example of a "Spring" wheat have been found, for Le Couteur had himself grown it every year and always as a Spring wheat ever since the year 1834. From one of these two ears I picked out ten of its grains, and planted them in a row in my garden in a very exposed situation, on the 1st November, 1861. Nine out of the ten plants from these

grains were killed by the sev
other plant remained perfectl
following harvest. That this w
planting the produce of this su
the whole of the resultant plant
I carried on this experiment fo
produce of each harvest in the
once affected even by the intens
February, 1864—in fact, it pro
although descended from a whea
for nearly thirty years been plant
than as a spring wheat.

I have given this at some
been always considered that,
might exist as to other distinct
distinct species. This is not diff
wheat been sown in the usual
would have perished, and thus ha
that spring wheat cannot be so
wheat, and is, therefore, entirel
same as to barley. In fact, it is
barley from Lapland, which the
comes to harvest, if sown here,
in two months, brings with it
more rapidly than home grown b
not the first to observe that the
corn, and *vice versa*, but it is indis
observed that the two can be cont
Not to weary you I will but brie
distinctions drawn.

Here it is necessary to state s
more fully explain—viz., that a sin
suitably, produces a plant consisting
I have found them upon the san

whether of wheat or barley, one or more ears bearded while all the others were beardless; and in the case of wheat, one ear of the plant red-chaffed while all the rest of the ears had a white chaff. Again, a white wheat sown on a fresh soil may at once become red. The composite ear is most strikingly different from all others in appearance, but I have found the ordinary ears bifurcated and showing a tendency to the composite ear.

This composite ear is what is popularly called "mummy wheat," as having been produced from grains of wheat taken out of mummies. No illusion could be greater, for wheat will not germinate after it is ten years old. The Pasha of Egypt, a few years ago, had this question fairly tried by opening several mummies and planting the grains from them along the banks of the Nile, with the result which I had confidently predicted, viz:— that not a single grain showed any sign of germination. And here I cannot refrain from giving you an anecdote relating to a similar question told me by Dr. Hooker, the present President of the Royal Society, when staying with me. It was this—The tomb of a Roman soldier had been opened, and lying in a heap upon the stomach of the body were found some raspberry seeds. These upon being sown grew and produced raspberry plants quite indistinguishable from the common English raspberry. So important was this considered that a book was specially published upon the subject, and was at once accepted as a standard work upon it. Subsequently Dr. Hooker was appointed by the Government (I think he said) to investigate the matter, and this is what upon close inquiry he found. These seeds had been exhibited on a tray before the learned Societies at Burlington House, and side by side with them, to show their perfect resemblance, a tray of the seeds of the ordinary English raspberry. The numerous *savans* took up portions of the seeds to compare them, the two of course became mixed, and the wonder was exploded.

Now if, as I have endeavoured to show, the characteristics supposed sufficiently inherent and permanent to distinguish "species" (not varieties) are upon close investigation in fact by no means invariable, these, to me at least, scarcely furnish sufficient evidence to preclude the opinion that all known varieties of wheat *may* through long periods of time have sprung from one common origin. In the very limited knowledge, however, to which even the best of us can attain, it would be presumptuous to go farther than this. Any speculations, however, as to the past of our cereals is but of little *practical* importance, compared with those as to their possible future, except, indeed, so far as they may tend to leave our minds untrammelled in the investigation.

The *practical* question then arises, what should all these differences (and a further, almost infinite number, of minor ones) teach us? Surely it is this, that here, as universally elsewhere throughout Nature, these variations do not take place hap-hazard, but follow the greatest principal of law and order manifested in all the works of the Creator. Such at least was the view I was led to take. That some parent grains must once have possessed different powers of production is evident enough from the numerous existing varieties, but it was equally evident that each of these varieties breeds true to itself. This breeding true, combined with a perpetual tendency to minor variations, seemed analogous to the case of a breed of animals, which while keeping always true to the main characteristics of the breed once established, yet admitted of almost unlimited further improvement by means of the lesser variations; secured (and added up step by step) through the great principal of inheritance.

I have said the breed once established, because it is a very singular fact that in establishing the breed of present improved shorthorn cattle the colour of the originals from which they sprung was black, while there is no such thing existing at present as a black shorthorn, and the number of instances of the nearest approach to it, a "blue roan," could probably be counted upon the fingers of one hand. Did the same thing apply to the cereals? Could we similarly improve each variety, and should we be at a disadvantage compared with, say, cattle in carrying this out? A cow, for instance, produces one calf at a time. A grain of wheat *planted suitably* will produce at harvest several thousands of grains. If all these grains are of exactly equal powers there is no advantage in this, but if they differ, then what a choice have we in each generation compared with that afforded by the single progeny of a mare, cow, or ewe. That they do differ became at once apparent upon the very first trial; indeed the produce of no two of them seemed exactly alike.

How then is the grain of superior productive power to be ascertained? Does it depend upon its situation in the ear? It was suggested in ancient times that the best grains lay in the middle of the ear. And this is the only instance of any difference *between the grains of the same ear* having ever been even suggested before my own experiments. Mr. Darwin, in his book "On Animals and Plants under Domestication," under "Cerealia," chapter ix., page 314, says:—

"As wheat is an annual, we thus see many trifling differences in character are inherited through many generations. Colonel Le Couteur insists strongly on the same fact in his persevering and successful attempts to raise new varieties by selection. He began by choosing the best ears, but soon found that the grains from the same ear differed, so that he was compelled to select them separately, and each grain generally transmitted its own character.

In a paper, which I had the honour to read before the British Association, at Exeter, 1869, I said that if Mr. Darwin really meant by this what the words imply, that Colonel Le Couteur grew separately, and in competition with each other, the grains from the same ear, and similarly the progeny of each generation after generation (as he must have done to find that each grain of the original transmitted its own character through many generations) and, in fact, that he had discovered that the grains of the same ear differed, it was attributing to Le Couteur some portion, at least, of what I have claimed as a perfectly original discovery. Now the fact is, that throughout Le Couteur's book there is no mention whatever of his having grown in competition with each other the grains of the same ear, nor has he once made any allusion which could lead to the supposition that he ever had the slightest idea that there existed any difference in their power. In a letter to me from Jersey, October 15, 1860, Colonel Le Couteur writes:—

"The great leading principle of my experiments was one which you have so well accomplished—the selection of the most productive wheat from a single grain, originally taken from the finest ear—my further test being to discover that most productive of the finest meal. Necessarily the variety which would produce the largest quantity of the finest, whitest, and most nutritious meal, or rather bread, per acre, would be the most precious. The Belle Vue Talavera is the produce of one grain."

What Le Couteur did was to raise a stock from a single grain and keep it pure. He planted the grains of an entire ear of each of 14 varieties, and compared the produce in quality and quantity of the different varieties. This was all he did as to selection, and it has not the slightest bearing upon my own principles of selection. Indeed, the result of his labours was to establish an arrest of development so fixed that I was quite unable in ten years' cultivation of his wheat to obtain the slightest variation in the direction of additional spikelets or of grains, although in upwards of 70 varieties from all parts of the world upon which I had experimented I had never once failed to obtain such increase, and thus I finally rejected, as unavailable for my purposes, that very wheat which was the final best outcome of Le Couteur's experiments. The simple fact was that he started with a single grain from a fine ear, and afterwards endeavoured to keep its produce pure, and by the competitive trials of different varieties, to discover, to quote his own words already given, "that variety which would produce the largest quantity of the finest, whitest, and most nutritious meal." He never went even so far as to attempt by selection to increase the size of the ear of any particularly variety, and thus, as in the case of the Talavera wheat referred to, unconciously, by frequent repetition fixed it. In 1858, I investigated this question of the grains differing in relation to their positions in the ear, by planting the grains of ten ears on a plan, showing exactly the situation in the ear of every one of its grains. In fact the planting formed a diagram of the ear.

The results were that situation in the ear does not supply any indication of the superior grains. Does it depend upon its size? So far as I can learn from actual trial, assuredly not. And here I am again unfortunate in Mr. Darwin's reference to this subject, for in his last new book on "Cross and Self-fertilization of plants," chap. ix., page 354, he says :—

"Loiseleur Deslongchamp (Les Cereales, 1842) was led by his observations to the extraordinary conclusion that the smaller grains of cereals produced as fine plants as the large. This conclusion, is, however, contradicted by Major Hallett's great success in improving wheat by the selection of the finest grains."

Now here finest clearly means largest, and this, notwithstanding that I had sent Mr. Darwin a copy of my paper, read at Exeter, in which the following occurs upon this point :—

"Frequent trials had also been made of the comparative power of large and small grains with uniformly the same result, viz. : That in good grains of the same pedigree, neither mere size nor situation in the ear supplies any indication of the superior grain."

It also contained the synopsis of the Law of Development, which will be given again in the present paper, and which defines accurately the principles of selection upon which I really do proceed. Of course I am not imputing to Mr. Darwin anything more than mere inadvertence through the pressure of multifarious subjects, but in the works of so great a writer I cannot see with silent equanimity what I really have done ascribed to another, while I am credited instead with acting upon a principle in which I have no reason to believe at all.

Can the superiority be ascert
the grains ? Again, no. Does it
gravity ? Here, I think, the true
we could accurately determine the
grains (very nearly alike) *without*
ation, for it is evident that it woul
supposed best grain if by discove
prevented our proving by actual
best, as supposed. But in fact we
any known process the relative sp
wheat without destroying their ger
page 41, says "It will be recolle
the relative specific gravity of each
grains were noted that exactly
course, this is not specific gravity.
of different densities in order to
a rough classification of their spe
growth to see whether this held
result. The fact is, I believe, tha
ing of the grain prevents accurate
thus the *accurate* measurement of sp
becomes practically of no value, f
that the difference between any t
minute. My belief is, and has long
of a grain depends upon, or is at
amount of gluten it contains ; that t
gluten possesses the greatest power o
that this power is identical with that

Leaving, however, the domain of
to that of practical experiment a
Society like your own, I will not tr
agricultural aspect, but first endeav
step, I was led up to the discovery
growth. Here I may, perhaps, be allo
that I came to take any interest in

from an acute disease which the medical men said any sedentary occupation, such as engineering, would have greatly aggravated, and my father happening to have a farm in charge of a Scotch steward, this seemed to offer the very occupation desired. Coming quite fresh and ignorant to so novel an occupation as wheat-growing, I became possessed with the idea that large ears would produce large ears, and finding, after diligent research, that there was no recorded experience upon the subject, I at once set to work to study the growth and nature of the wheat plant. I determined to treat the plant as if it were an entirely new one, and planted single grains a long way apart, in order to study their development. Let us then see, by following its growth, what the nature of the plant is. A grain of wheat planted at a certain depth below the surface sends up first a single stem, its rootlets being simultaneously developed. Shortly after this first stem appears well above the ground it throws out a succession of new stems; as each of these commences to form, a new rootbud is developed from its support; and as these new stems bend down and grow out horizontally over the surface, the respective new roots are correspondingly developed beneath it. The process is called "tillering." At the proper season it ceases, the stems rise to a vertical position, develope their ears, and grow upwards to maturity. The extent to which this tillering may go may be gathered from the three following facts as to the roots, the stems, and the ears produced.

1.—In 1862 I had two boxes made—each two feet square and two feet deep, having a capacity of eight cubic feet in each. In each I had a living plant of wheat from one single grain. In order to show at the Battersea Exhibition of the Royal Agricultural Society the root development, I had a large portion of one side of each box made as a door with hinges. Upon these being opened it was at once seen that the roots completely filled the whole box and the extremities of the rootlets formed at the side of the box a dense white mass exactly as do those of a plant left too long in a flower-pot not sufficiently large for it.

2.—As to the extent of the tillering of the stems, I had a plant of wheat in May which measured (as across the centre of a wheel laid horizontally) from the extremities of the leaves of the longest stems 5ft. 6in. in one direction, and 5ft. 4in. the other. In other words, it covered a circle of nearly six feet in diameter.

3.—I have now in my possession a plant of wheat consisting of 153 ears produced from a single grain planted the preceding autumn, and I have had a similar plant of barley with 110 ears upon it.

Thus far, as to the general nature of the cereals. Let me now present to you, as fully as the limits of such a paper as this permits the results of actual experiments extending over more than 20 years. The first results obtained were from wheat, of course of unknown lineage; for, as a matter of fact, there was no wheat (except Colonel Le Couteur's which did not come into my hands until several years afterwards) which could in any degree be said to have an authenticated lineage, but I obtained the best example procurable. These first results at once confimed the crude original idea with which I started, viz., that large ears would certainly produced large ears. But they showed more than this. The grains *from the same ear* (as was afterwards found in Le Couteur's wheat before referred to) were not alike in productive and other powers.

It was this latter fact which deeply impressed my mind as opening up a field of inquiry at once much wider and more refined than any I had theretofore imagined. Were these differences inherent in the very nature of the plants, or were they merely the reversions of an uncertain bred race to some former ancestors in its (unknown) lineage? This question could be solved only by obtaining a cereal with a known recorded lineage. Pursuing then this branch of inquiry, I found from repeated trials (and it must be borne in mind that in this case each trial means a whole *year*) that the powers of the grains from the same ear did not become equalized, in spite of the fact that the ear itself was now known to be descended from a succession of best grains (known to have been best by having produced the best plants of the year following), although these differences were unquestionably reduced in amount. The fact of these differences being thus found in at least some degree to be reducible by even such a short series of experiments led me to expect that they might, as the result of a much more extended series of recorded breeding, be practically removed, and the whole brought up at least to the standard of the then best. But extended trials showed that although still further reduced in amount these differences would still exist. The grains of a large ear produced large ears as was anticipated, but one of its grains (now of known lineage) would still produce larger ears than would any of the other grains of the ear.

The question then presented itself, was this some law of nature? I took the best plant of the year, picked out the grains from each of its ears, and planted the grains of each ear in a separate row, but still always with a like result. A new fact now presented itself to my notice, viz.: that the ears of any plant were invariably unequal. Throughout continued observations and experiments extending over more than twenty years, I have found only three instances recorded in which there were two ears on a plant containing an equal number of grains, and one of these related to the Belle Vue Talavera wheat, which must be considered quite exceptional as to variation. In both the other instances there was only a low stage of development, the equally finest two ears of each plant containing but 59 grains and 49 grains respectively. In every case where the plant presented an ear containing 60 grains and upwards, the next best ear was of less contents than the finest one. In 20 such instances taken consecutively and without omission from my journal, and referring to seven varieties of wheat, the average difference between the contents of the first and second ears was seven and a half grains. The difference in four of these instances was only one grain, but in other four it amounted to from 17 to 19 grains. Thus there is on every plant a best ear, just as there is in every ear a best grain. Are, then, the best grains of each ear of the same plant equal? Actual trials showed that they were not only not equal but that there was one superior to all the others; in other words, among all the grains of the ears of any plant there is *one ultimate best grain*. Further on it was found that this ultimate best grain of any plant lies *in its best ear*.

Thus, then, we arrive at last at the following as the law of development:

1.—Every fully developed plant, whether of wheat, oats, or barley, presents an ear superior in productive power to any of the rest on that plant.

2.—Every such plant contains one grain which, upon trial, proves more productive than any other.

3.—The best grain in a given plant is found in its best ear.

4.—The superior vigour of this grain is transmissible in different degrees to its progeny.

5.—By repeated careful selection the superiority is accumulated.

6.—The improvement, which is at first rapid, gradually, after a long series of years, is diminished in amount, and eventually so far arrested that, practically speaking, a limit to improvement in the desired quality is reached.

7.—By still continuing to select, the improvement is maintained and *practically* a fixed type is the result.

A "pedigree" cereal, then, is one re-started from a single grain every year and thus descended from a long line of single grains each the ultimate best grain of the best plant of its year actually proved so (in the year following) by planting all the grains of the plant in competition with each other. Stated otherwise, the ultimate best grain of its year is *proved to be so* by its actually producing the best plant in the year following. In illustration of these principles of selection, I now give the following results due to their influence alone—as the kind of seed, the land, and the system of culture employed were precisely the same for every plant for four consecutive years; neither was any manure used, nor any artificial means of fostering the plants resorted to.

TABLE SHOWING THE IMPORTANCE OF EACH ADDITIONAL GENERATION OF SELECTION.

Year.		Length inches.	Containing grains.	Number of ears on finest plant.
1857	Original ear	4⅜	47	...
1858	Finest ear	6¼	79	10
1859	Finest ear	7¾	91	22
1860	Ears imperfect from wet season	...	...	39
1861	Finest ear	8¾	123	52

Thus, by means of repeated selection *alone*, the length of the ears has been doubled, their *contents* nearly trebled, and the "tillering" power of the seed increased five-fold. I have given the results obtained in these particular years—1857-1861—because, being the first years of the series of the wheat with which I originally commenced, the improvement was, as already stated, more rapid, but also especially because increased contents of the ears was in these selections the sole object sought; whereas, since 1861, other points besides the increased contents of the ear governed the selections, and thus the improvement in this particular was not in the other varieties, even in the first years of each series, so rapid.

I will now give a tabular statement of the results obtained over a very extended series of years, in which I shall show clearly that, notwithstanding the unfavourable years which we have lately gone through, the effect of the repeated annual selection of the *actual best plants* for breeding purposes has been to so raise the normal standard of productiveness that the *contents* of the original ears of each variety (those ears the very best, be it always remembered, which could be found *anywhere*) have practically been doubled, and this, notwithstanding that the wheat was grown throughout that long period without once having the advantage which a change of soil gives. The following table shows the increased contents of ear obtained in four varieties of wheat by repeated selection continued in one instance for twenty years.

Year.	The Original Red.		Hunters.		Victoria.		Golden Drop.	
	Grains in the best ear.		Grains in the best ear.		Grains in the best ear.		Grains in the best ear.	
1857	47							
1858	79							
1859	91							
1860	87*							
1861	123							
1862	93		60		53			
1863	97		90		60			
1864	59		91		69		32	
1865	92		81		76		39	
1866	88		110		86		75	
1867	76		95		87		61	
1868	98	92	121	105	106	102	82	81
1869	111		124		113		74	
1870	106		111		98		81	
1871	91		89		114		77	
1872	71		117		101		96	
1873	83		100		78		74	
1874	92		98		104		81	
1875	90		92		97		80	
1876	86		93		103		84	

* Supposed ears imperfect from wet season.

					Total grains.
Contents of the original ear of each variety at starting.	47	60	53	32	=192
Average contents of best ear annually of each variety throughout last 9 years of series.	92	105	102	81	=380

The *average* productive powers of each kind of wheat is here clearly doubled.

In conclusion I will briefly explain the *practical* bearing of these results. The bushel of ordinary wheat containing about 700,000 grains, by the present practice of sowing two bushels of wheat, nearly one and a half millions of grains are deposited upon an acre of land. The number of ears produced upon an acre never equals this. Whether we plant single grains one foot apart each way, or nine inches apart each way (if we plant them sufficiently early), or whether we sow one bushel, two bushels, or three bushels per acre, the *number* of ears produced per acre is practically the same. In June, 1874, I was on a visit to a friend farming some 4,000 acres in the Vale of Eversham, who had two plots of my wheat—the one planted with single grains twelve inches apart every way (but not early enough), the other with grains nine inches apart every way. The ears were magnificent, but everyone talked of it as the "thin" wheat. He was much astonished upon my telling him that there were as many ears per acre on the plot planted nine inches apart (the other plot was not planted soon enough for the greater distance) as he had on any of his magnificent fields of wheat drilled with one bushel, or with two bushels, or with three bushels, per acre, if he could show me any such. He, his son, and I forthwith proceeded to test the matter, with the following result, which astonished him even more than the apparent boldness of my original assertion :—

	In. In.		Ears per square yard.
Single grains planted (too late) ...	12 × 12	gave ...	229
" " "	9 × 9	" ...	276
Drilled October 11 ... 1 bush. per acre		" ...	263
" " ... 2 " " "		" ...	283
"Coles' Field" drilled end of October 2 " " "		" ...	265
"Dears" drilled Nov. 3.......... 3 " " "		" ...	269
		4	1080
		Average..............	270

or six less per yard than the number produced by single grains nine inches apart each way. And this does not fully represent the whole truth, for many of the stems of the thick sown wheat, credited each with an ear, would fail to produce one at harvest, while every one of the stems counted upon the single-grain plots would produce a fully developed one.

The Agricultural Returns now furnish us with pretty correct information as to the acreage of wheat grown in the United

Kingdom, but until within the last few years we have been without this knowledge. Nevertheless, statements have been for more than a century past confidently made upon this point, and are often now repeated by those who are considered authorities upon the subject. The only foundation upon which such statements rest are an assumed consumption of so many bushels per head, the returns as to population, the deduction of the known imports, and the division of the remainder by the number of acres grown in the United Kingdom—which number of acres was, until the quite new institution of Agricultural Returns itself, absolutely unknown.

What value can be attached to such estimates, which are, in fact, mere guesses? It is sufficient for my present purpose to take 40 bushels per acre as an excellent and thoroughly good crop. This gives us 28 millions of grains as the produce of one million ears per acre, or 28 grains only per acre! And this, for the purposes of my present contention, is putting the case as strongly as possible against myself. For if the average crop be taken (as supposed) at 30 bushels per acre, the number of grains produced becomes reduced to 21 millions, or only 21 per ear; while if 1¾ millions of *ears* per acre be claimed, the produce per ear can even upon a crop of 40 bushels amount to only the same. But if, while maintaining the number of ears per acre, we double their contents, this is doubling the crop, and would save annually the sending out of the country a sum equal to the interest upon the National Debt! Beyond the increased contents of the ears produced in fully-developed plants, the increased size of the grains alone adds 40 or 50 per cent. to the crop. Thus a bushel of fully-developed pedigree wheat contains 460,000, a bushel of ordinary wheat 700,000 grains. Therefore, in two crops consisting of precisely the same number of grains, that from fully-developed plants would be 70 bushels against 46 bushels, or 2 quarters against 6 quarts per acre. So in barley the crop would be from this cause alone 7 quarters against 5 quarters per acre.

As this has been in fact a history of my labour in working out this subject, I should be most ungrateful not to acknowledge the generous support and encouragement given me from the first by the Press, throughout my own and foreign countries, as also by several kind friends, and by none more than the late Mr. Merrifield, when such support and encouragement were especially welcome; but I shared, what is, I suppose, the fate of all pioneers, meeting generally with obstinate prejudice and opposition for many years, and that, too, from those who should have been the very first to give me their countenance. However, I went steadily on upon the *magna est veritas* principle, and I am happy to say this has pretty well all died away, and I now reap a sufficient reward in finding my system officially adopted by the Governments of other countries and by agriculturists generally, abroad as well as at home. I thank you for having so patiently listened to a paper which has grown under my hands much longer, and, I fear, more tedious, than I had at the outset intended it to be.

The **President**, Mr. G. D. Sawyer, on behalf of the meeting, heartily thanked Major Hallett for his paper, one of the best with which the Society had been favoured for a long period.—A long and interesting conversation followed.

The **President** opened it with a few remarks expressive of the results of his observation of wheat producing, which led Major Hallett to state that Jethero Tull said that 90 per cent. of a square yard of very thickly sown wheat would be missing at harvest, and to point out that the development on the stems ceased as soon as the roots became impeded by crowding—as soon as, in Darwinian phraseology, there was a struggle for existence.

In reply to Dr. **Corfe**, the Major remarked that in all his experiments he had employed no manure, his object being to ascertain, so far as he could, the relative value of each grain, an object whose attainment would be defeated if any substance was used which might tend to the superiority of one growth over another, by an unequal distribution of that substance.—Mr. C. F.

Dennet highly complimented Major Hallett upon the resolution, courage, and perseverance, which he had exhibited in carrying out his experiments.

Mr. W. **Saunders** made a few remarks which induced the Major to affirm that there was nothing in his system which should prevent quantity going hand-in-hand with quality. Neither, said he, in answer to a question from the President, was much time or labour expended in following out his system as compared with that usually spent.

Mr. J. **Hamblin** and Mr. J. E. **Haselwood** were among the other interrogators, and, in reply to the latter, Major **Hallett** assured the meeting that but for selection the inherent power of the wheat would be lost—the avoidance of over-crowding in planting was insufficient to retain it.

May 24th.

MICROSCOPICAL MEETING.

The **President** (Mr. G. D. Sawyer) expressed his pleasure at hearing that one of the hon. secretaries (Mr. T. W. Wonfor) was still improving in health, and was expected to be enabled to get out of doors in a few days. He also stated that Mr. John Mayall, jun., F.R.M.S., had found such difficulty in getting a lens which was necessary for the elucidation of the subject of the paper he had intended reading that night, on "The Microscope: its Modern Development," that he was compelled to withold that paper till their next microscopical meeting, which would be held on the fourth Thursday in June. Under these circumstances the meeting would resolve itself into a conversazioné, and would devote itself to the examination of objects under the microscope, provided by Mr. J. E. Haselwood, Mr. R. Glaisyer, the librarian, and himself.

JUNE 14TH.

MR. H. GOSS, F.L.S., F.G.S., &c., ON "THE INSECT FAUNA OF THE SECONDARY OR MESOZOIC PERIOD, AND THE BRITISH AND FOREIGN FORMATIONS IN WHICH THEIR REMAINS HAVE BEEN DETECTED."

I do not propose, in this paper, to make any preliminary observations on the importance of an acquaintance with fossil entomology, or on the valuable conclusions bearing upon the geological conditions of the earth in former ages, which may be arrived at from a study of insect remains. Such observations as I had to offer on this portion of the subject have already been made, in the introduction to my first* paper, an acquaintance with which I shall presume on the part of all hearers and readers of this, the second, paper of the series.

In the secondary rocks of this country, insects in a fossil state are well represented. For our knowledge of them we are indebted mainly to the Rev. P. B. Brodie, M.A., F.G.S., who, as I before stated in my first paper, is the author of the *only book* on fossil insects which has as yet been published in this country. In the determination of a large number of the insects described and figured in this book, as well as for some very important introductory observations therein, Mr. Brodie had the great advantage of the assistance of Professor Westwood, M.A., F.L.S. We are indebted to Mr. Brodie not only for the very interesting and valuable work before mentioned, but also for numerous important papers and notices on fossil insects which have, from time to time, appeared in the "Proceedings of the Geological Society," the "Quarterly Journal of the Geological Society," the "Annals and Magazine of Natural History," the "Proceedings of the Warwickshire Naturalists' Field Club," and elsewhere. Amongst the names of other contributors to our knowledge of the fossil insects of the British formations of this period, I must not omit to mention those of Professor Buckman, Messrs. W. R. and H. Binfield, Professor Morris, F.G.S., Dr. Mantell, F.R.S., Professor Edward Forbes, F.R.S., Mr. W. R. Brodie, Mr. C. Wilcox, the Rev. O. Fisher, Captain Woodley, the Rev. Dr. Buckland, F.R.S., the Rev. J. H. Austen, the Rev. E. F. Witts, Mr. H. E. Strickland, F.G.S., Mr. Arthur Gardiner Butler, F.L.S., Mr. S. H. Scudder, Mr. E. T. Higgins, &c.

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* See paper on "The Insect Fauna of the Recent and Tertiary Periods &c.," read before the Society on the 8th March, 1877.

The British formations of this epoch, in which insect remains have as yet been discovered in the greatest number, are the upper series of the Upper Oolite (*i.e.*, the Purbecks) and the Lias. The only other formations of the period in which they appear to have been yet discovered in this country are the Hastings sands, and some other subordinate members of the Wealden system, the Kimmeridge clay of the *Upper* Oolite, the Oxford clay of the *Middle* Oolite, the Forest Marble, *Great* Oolite, and Stonesfield Slate of the *Lower* Oolite; and the Rhœtic series between the Lias and the Trias. As yet no remains have been recorded from the British upper cretaceous system, the upper members of the lower cretaceous, or Neocomian system, the Portland stone and sand, coral rag, Kelloway rock, Cornbrash, Fuller's earth and inferior Oolite, or from the Trias. It is needless to say that one must not infer that because no insects have as yet been discovered in these strata, none existed at the different geological epochs of their deposition. Either they have been overlooked, or their absence may be accounted for by the fact that as these formations are of marine origin, the circumstances attending their deposition were unfavourable to the preservation of the insects of the period, and that, consequently, we have few or no traces of them. Although, as I have observed in my first paper, the presence of insects in marine formations may in some cases be accounted for by supposing them to have been driven by the wind into the sea when in its neighbourhood, or when attempting to cross it, yet, as a rule, where their remains have been detected in any abundance in decidedly marine formations, this may generally be considered as satisfactory evidence that land was not far distant at the time they became embedded; and the abundance of other terrestial remains, usually accompanying these fossils in marine formations, leaves but little doubt upon the subject. One notable exception to this rule is the continental formation known as the "Solenhöfen Slate" of Bavaria (belonging to the Upper Oolite), in which the remains of insects are said to be mixed up, almost exclusively, with the débris of the marine animals and plants. Numerous lacustrine deposits have been discovered in the middle of the marine formations, constituting the greater part of the Jurassic system, which are supposed to indicate the situation of ancient islands. If this supposition be correct, the presence of the remains of terrestrial animals and plants in marine formations is easily accounted for.

Before proceeding to review the various strata of the period in which fossil insects have been detected, I think it may not be out of place to call attention to the striking difference in the state of preservation of the insects from English formations to this period, with that of those from one of the most important of the foreign formations (*i.e.*, the Solenhofen Slate). On the subject of the deposition of the Solenhofen insects, I cannot do better than quote Dr. Hagen,* who observes, "on comparing the insects of Solenhofen and Eichstadt with those of England, there appears, in the first place, a difference which may possibly admit of interesting inferences; the insects of the Bavarian strata are almost universally preserved entire; wings, legs, head and antennæ are in their proper places; most of the *Libellulæ* have their wings expanded. He who has noticed on the sandy shores of the Baltic how depositions of insects are now taking place, will admit that the insects of the Solenhofen strata were already dead when deposited." The insects would be, as now, driven by the wind into the sea, thrown on the shore dead or dying, and there

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*See a paper read by Dr. Hagen before the Geological Section of the British Association at Manchester, September, 1861, and see the Entomologists' Annual for 1861.

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insects of the Solenhofen slat

Professor Germar,* Count Munster, and Dr. Hagen. To Dr. Hagen we are especially indebted for making us acquainted with the numerous gigantic *Neuroptera* obtained from this formation. To Professor Oswald Heer we owe our knowledge of the fossil insects from the Lias of the Swiss Alps. This indefatigable savant, in comparison with whose labours in this particular branch of science those of other palæontologists sink into comparative insignificance, has obtained from Schambelen about 2,000 specimens of insects, comprising 143 species. A most interesting account of these insects and of the strata in which they have been found is given by Dr. Heer in his Urwelt der Schweiz," an English translation of which by Mr. W. S. Dallas, F.L.S., edited (with some additions) by Mr. J. Heywood, F.R.S., has recently been published. With the exception of one insect from the Swiss carboniferous system and five from the Trias, these insects from Schambelen are the most ancient in Switzerland, and consequently possess great interest. Among the names of other students of, and writers on, the fossil insects of the continental formations of this period, must be mentioned Schmiedel, Schroter, Esperm, Van der Linden, Van Buch, Von Meyer, Dr. Geinitz, Marcel de Serres, Professor Bronn, Professor Pictet, Dr. Giebel, and Herr Weyenberg. I will now review, as briefly as possible, in the descending order of geological succession, the various strata of this period, in which insect remains have been detected, and the several orders and species to which such remains have been referred. The English strata and their remains will be treated of before proceeding to those of the Continent.

BRITISH STRATA.

FLOWER CRETACEOUS OR NEOCOMIAN.

In the Lower Cretaceous or Neocomian system remains of insects are extremely rare and confined, so far as present investigations enable us to judge, to the very lowest members ot the series. The first remains recorded from these strata were discovered in the neighbourhood of Hastings by Messrs. W. R. and H. Binfield. They consisted of a few minute *elytra* and fragments of *Neuropterous* wings, and were obtained in the courses of ironstone exposed near low water mark, at a place called the "Govers," near St. Leonards-on-Sea. Above the course of the ironstone, in a bed of dark coloured shale, many *elytra* were found, as well as traces of wings of *Coleoptera*, *Neuroptera*, and *Diptera*. A few fragments of *Coleopterous elytra* have also been discovered in the Wealden marlstone, from between Tonbridge and Maidstone, and are mentioned by Dr. Mantell. In the proceedings of the Geological Society for 1854, Professor Westwood alludes to the discovery, by Professor Edward Forbes, of some traces of fossil insects in the Hastings series of the Isle of Wight, and of a few doubtful specimens, by Mr. W. R. Brodie, in the Wealden series of Punfield Bay Swanage.

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* Ueber die Versteinerten Insecten des Juraschiefers von Solenhofen, 1837.

UPPER OOLITE.

PURBECK BEDS.

In Mr. P. B. Brodie's valuable and interesting work on "The Fossil Insects of the Secondary Rocks of England," these beds are referred to the Wealden formation; but modern geologists are of opinion that in consequence of the organic remains discovered therein, the Purbeck series has a close affinity to the Oolitic group. It may, therefore, be considered the newest or uppermost member of that formation, instead of the oldest or lowest member of the Wealden formation. The "Purbeck beds" are of freshwater origin, and are so named from the Peninsula of Purbeck in Dorsetshire, in the cliffs of which they were first studied. These beds are of but limited geographical extent in Europe, but they are of great geological importance, on account of the succession of* three distinct sets of fossil remains which they contain, these again differing from the fossils of the overlying Hastings sands and Weald clay. This series is best seen at Durdlestone Bay near Swanage, at Lulworth Cove, and the neighbouring bays between Weymouth and Swanage. The Purbeck beds were divided by Professor Edward Forbes into the upper, middle, and lower. It is from the middle and lower divisions that the greatest quantity of insect remains have been recorded. These remains have been discovered principally by the Rev. O. Fisher, Mr. W. R. Brodie, Captain Woodley, Mr. C. Wilcox, and especially by the Rev. P. B. Brodie, of whom Professor Westwood observes that, "from his attention having been especially directed to this branch of the subject, he has been highly successful in detecting minute fragments of insect remains in small slabs of stone, which would to a less educated eye have been passed over as destitute of any traces of ancient animal life." * In the "Quarterly Journal of the Geological Society" for 1846, Mr. Brodie recorded the discovery of a few imperfect remains of insects in Purbeck strata, in the neighbourhood of Swindon, Wilts. A large collection of insect remains, consisting of one hundred and eighteen† small slabs, containing many specimens, was made by Mr. Brodie from the middle Purbeck of Durdlestone Bay, Dorsetshire. These remains included elytra, bodies, and wings referable to *Coleoptera*, *Orthoptera*, and *Diptera*, and portions of wings of *Neuropterous* insects of doubtful family. A number of specimens of fossil insects were obtained by the Rev. O. Fisher from the Ridgway Quarries near Dorchester, belonging to the lower Purbecks. A large collection of fossil insects was also obtained by Mr. Wilcox from the Purbeck beds near Swanage; the collection consisted of some 60 slabs, each containing a number of remains. Professor Westwood says these remains included a very extensive series of elytra of *Coleoptera*, including *Buprestidæ* and *Harpaldæ*, also fragments of the wings of *Libellulidæ*, *Blattidæ*, *Tipulidæ*, &c. A small collection of insect remains, twenty-two in number, was made by Mr. W. R. Brodie, of Swanage. Professor Westwood states that these remains included *Elateridæ*, *Helopidæ*, *Curculionidæ*, and the wing of a gigantic Ant, which, in its perfect state, must have measured at least two inches across the expanded wings; it is most nearly allied to some of the exotic forms of which *Myrmica* is the type in temperate regions. "The discovery of such an insect," says Professor Westwood, "is of the highest importance in respect to the question of the geographical range of the insects embedded in the lower Purbeck series." The largest collection of insect remains from the lower Purbecks was made by the Rev. P. B. Brodie. "It consisted," says Professor Westwood, "of three hundred and fifty small slabs of stone of various sizes. Upon many of them only a single fragment of an insect occurs; but upon a considerable number, the remains are very numerous, the fragments being crowded together, and often lying one upon another." These remains, of course, included quantities of elytra of *Coleoptera*, and also wings and wing covers of *Neuroptera* and *Orthoptera*, and two wings supposed to be *Lepidopterous*. The very fragmentary nature of these insect remains rendered the identification of the majority of them a matter of impossibility, but from Professor Westwood's paper in the proceedings of the Geological Society for 1854, and the list of species in Dr. Giebel's* "Fauna der Vorwelt" some eighty-six species seem to have been determined, viz.:—

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* "Lyell's Elements," 6th edition, p. 377, and see a paper on the Dorsetshire Purbecks, by Professor Edward Forbes, British Association, Edinburgh, 1850.

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* "Quarterly Journal of the Geological Society," 1846, vol. III., pp. 53-54.

† "Proceedings of the Geological Society," 1854.

	Coleoptera...	... ...	45 species.
	Orthoptera	... ...	12 ,,
	Neuroptera	... ...	10 ,,
	Hemiptera	... ...	11 ,,
	Diptera ...	... ...	4 ,,
	Hymenoptera	... ...	2 ,,
(supposed)	Lepidoptera	... ...	2 ,,
			86

The two supposed species of *Lepidoptera* were respectively named, by Professor Westwood, *Cyllonium Boisduvatianum*, and *C.*

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* Fauna der Vorwelt, pp. 187, 393, and 426.

Hewitsonianum. Both species are included by Dr. Giebel in his list. On the subject of these supposed remains of *Lepidoptera* Mr. Scudder observes: "I have not been able to find, even with Mr. Brodie's help, the first specimens referred to; but an examination of the original of the latter proved that while it is unquestionably an insect it cannot be referred to the *Lepidoptera.* As the figure of the first species clearly resembles, in this particular, the one I have seen, I am forced to the conclusion that neither of these wings are *Lepidopterous.* Plainly, the only reason why a new generic name was appended to these forms, was that their remains were too fragmentary to afford the slightest guess as to what modern genus they might be referred." All geologists are, of course, aware that the formation known as the "Purbeck Beds" occurs not only in the peninsula of Purbeck in Dorsetshire, but also in some parts of Wiltshire and Buckinghamshire, and elsewhere. This formation in the vale of Wardour in Wiltshire, consists, according to Mr. P. B. Brodie, of a series of clays, white limestones, grits, sandstones, coarse blue limestones, and fine white slaty limestones. In this last-mentioned limestone, insect remains have been detected in such abundande, that it has been called, both here and in Dorsetshire, the "Insect Limestone." It is described as being of a somewhat coarse texture, often white at the edges, and of a blue colour towards the centre, where it becomes fine grained and harder, and then joins into a thin white slaty limestone, very fine grained and having a laminated structure. It was chiefly from these strata in the vale of Wardour in Wilts, and the vale of Aylesbury in Bucks, that the large collections of fossil insects were obtained which furnished materials for Brodie's "History of the Fossil Insects in the Secondary Rocks of England," before referred to. Out of some two hundred and forty specimens, or parts of specimens, from these formations, seventy-four * were figured by Professor Westwood in the work last mentioned. The very fragmentary and imperfect condition of a great quantity of the insect remains discovered in these formations rendered it impossible, even for so skilled an entomologist as Professor Westwood, to determine, in many cases, the species, or even the *orders*, to which they belonged. A great many have, however, been identified, and, according to the lists given by Mr. Brodie in his "History of the Fossil Insects in the Secondary Rocks," and by Dr. Gliebel in his "Fauna der Vorwelt" (Insekten and Spinnen), the following orders are represented by some sixty-four species, distributed amongst them in the following proportions, viz.:—

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* Introductory observations to Brodie's "Fossil Insects," by Professor J. O. Westwood, M.A., F.L.S., &c.

Coleoptera...	18 species.
Orthoptera	10 ,,
Neuroptera	9 ,,
Hemiptera	14 ,,
Diptera	13 ,,
	64

The *Coleoptera* appear to have been very well represented, and to have included *Buprestidæ*, *Carabidæ*, *Curculionidæ*, *Chrysomelidæ*, *Elateridæ*, *Cantharidæ*, *Tenebrionidæ*, and *Halophoridæ*, Professor Westwood also detected amongst the insect remains from this formation *Cercopidæ*, *Cimicidæ*, *Tipulidæ*, *Simulium*, *Blatta*, *Aphis*, *Acheta*. Of the species which have been determined a large proportion are said to be herbivorous, and as the remains of plants are stated to be abundant in this formation, we have reason for believing that the flora of the period was luxuriant. Some of the species detected are certainly not herbivorous, but the number of species which are vegetable feeders implies some abundance of carnivorous or predaceous ones. On the subject of the remains from the Dorsetshire Purbecks, Professor Westwood observes, "With the exception of the dragon flies, of which there are as many as 34 fragments of single wings (from, which however, it is impossible to affirm either a moderate or tropical climate) and of a large Ant wing, it is worthy of remark that the whole of these remains, not fewer than 700 or 800, are those of minute insects, not more than a fourth or a third of an inch in length." Further on in the same paper he says, "If we take into consideration the small and even minute size of the great majority of the insects, and, indeed, of the whole of the *Coleoptera* which have been passed under review, the idea that we have before us the wreck of an insect fauna of a temperate region is at once raised; for, although it would be rash to assert that a mass of the existing tropical insects might not be accumulated in which a large quantity of minute beetles and flies would not be present, yet I cannot conceive any process either arising from currents of water or chemical dissolution of insect matter, which would carry off or destroy the many gigantic forms of insect life always occurring in the tropics. The fossils before us show abundant evidence of the presence of numbers of lignivorous species such as *Elateridæ* and *Buprestidæ*; but we nowhere find amongst them traces of the great *Lamellicorn* and *Longicorn* Beetles. Herbivorous insects also occur in considerable numbers, but we do not meet with the gigantic Grasshoppers and Locusts of tropical climates." Professor Westwood goes on to observe that the question of by what means such masses of insect remains could have been brought together, as are found in the slabs of stone from this formation, is one for Geologists to decide. Entomologists, however, are aware that sudden inundations, or the rapid rising of rivers, are sure to bring with them vast numbers of insects, which are carried away by currents in vast numbers, and congregated together in masses. It appears, according to Professor Westwood, that with the exception of the gigantic winged ants and the wings of monster dragon-flies, that there is a very general conformity between the insects from the Dorsetshire Purbecks and those of Wilts and Bucks. There would, however, appear to have been a great difference in the manner of disposition of the strata of the two districts, as evidenced by the remarkable contrast presented by the state of preservation of the insect fauna of the Wiltshire Purbecks, and that of the insect fauna of the Dorset Purbecks. In the *former*, numbers of specimens are in a fair state of preservation, while in the *latter*, the remains consist of almost always of fragments of wings, elytra, or bodies. It appears from a careful examination of the fossil insect remains from these for-

mations, that the insects of thi
closely allied to forms now in e
as Mr. Brodie observes, " quite
led to infer from the rest of the
Thus while we have in the Pu
races among other divisions of
which accompany them are more
and present, upon the whole,
indeed, the greater part must
temperate climate, although so
higher temperature. This is t
colossal saurians, palms, and
evidently belonged to a hot
are chiefly confined to the
(*i.e.*, the Wealden proper); "
lower or Purbeck beds are eq
as the remains of the Megalo
cycas clearly prove."

KIMMERI

Below the well known
quarried for building purposes, i
Portland sand, immediately belo
The Kimmeridge clay is said by
a bituminous shale, sometimes
hundred feet in thickness. A
according to Mr. Brodie, this cla
laminated stone about two feet
thick strata of dark coloured s
blocks of Septaria, in one of w
striated elytron of a small beetle.
record of the discovery of any
the Upper Oolite system.

MIDDLE

OXFORD

The Oxford clay consists p

blue clay, including in some places, subordinate courses of limestone called Kelloway rock. The only trace of insect remains from this division of the Oolitic group is the supposed larva of an insect, found by Mr. J. C. Pearce, near Christian Malford, which Professor Westwood thought might possibly be referred to a *Libellula*. As the Oxford clay is supposed to have been deposited in a deep sea, remains of insects are hardly to be expected in it.

LOWER OOLITE.

FOREST MARBLE.

The forest marble is found immediately below the cornbrash, and belongs to the upper series of the Lower Oolite. It is said to be composed chiefly of thin fissile and slaty oolitic limestones, divided by clays, sometimes by sand and grit. The only record of the discovery of fossil insects from these strata is made by Mr P. B. Brodie, who states that in some of the quarries in this series, at Farleigh, near Bath, he found a few elytra of small beetles. They are undescribed.

GREAT OOLITE.

In the list of fossil insects at the end of Mr. P. B. Brodie's paper on "The Distribution and Correlation of Fossil Insects," &c., I find a record of elytra of *Coleoptera* from the Great Oolite formation, in the eastern moorlands of Yorkshire. The discovery of these remains is also alluded to by Dr. Mantell in the "Medals of Creation;" by Dr. Buckland in the "Bridgwater Treatise;" by Mr. R. C. Taylor, in the III. Vol. of "Loudon's Magazine of Natural History;" and by Messrs. Young and Bird, in their "Geology of Yorkshire." In a note at page 379 of the "Geological Proceedings for 1854," reference is made by Professor Westwood to a fossil insect having been met with by Professor Morris in the Great Oolite of Lincolnshire.

STONESFIELD SLATE.

The Stonesfield slate lies at the base of the Great Oolite, and is found chiefly in Oxfordshire and in the Cotteswold Hills, Gloucestershire, though there are, I believe, similar beds at Kettering, Northamptonshire, and near Stamford, in Lincolnshire. It is described by Lyell as "a slightly oolitic shelly limestone, forming large lenticular masses, embeded in sand only six feet thick, but very rich in organic remains." Mr. Brodie says the (Stonesfield) slate beds are largely developed in the north east of Gloucestershire, and have been traced from Wooton-under-edge to the neighbourhood of Burford. From thence they may be followed in a more northerly direction, and are well exhibited near Bourton on the Water, Upper Slaughter, Stow-on-the-Wold; and on the west at Eyeford and Maunton to their farthest limit in this direction at Sevenhampton, six miles east of Cheltenham. The remains of insects in this formation appear to be almost confined to a few families of *Coleoptera*, and they are generally in a very fragmentary condition, and consequently most difficult to determine. In the second volume of the "Geological Proceedings," Dr. Buckland has described the wing of a large *Neuropterous* insect from the Stonesfield slate, which has been named *Hemerobioides Giganteus*. In the list at the end of Mr. Brodie's paper on "The Correlation and Distribution of Fossil Insects" before mentioned, another specimen of a *Neuropterous insect* is mentioned (*Libellula Westwoodii*) besides two large wings, referred to the *Libellulæ*, which were found at Eyeford on the Cotswolds by Mr. Brodie. The remains of *Coleoptera* from this slate have been referred by Brodie and Westwood to some seven families, including *Buprestidæ*, *Curculionidæ*, *Coccinellidæ*, *Prioniidæ*, *Blapsidæ*, and *Pimeliidæ*. By far the most interesting insect fossil from the Stonefield state is the wing of a large insect, which Mr. Butler, Professor Westwood, and Mr. Bates believe to be *Lepidopterous*. In the proceedings of the Entomological Society of London, for 1872, we find the following notice of its exhibition at a meeting of that Society. "Mr. Butler exhibited a remarkably perfect impression of the wing of a fossil butterfly in the Stonesfield slate. It appeared to be most nearly allied to the now existing South American genus *Caligo*. Mr. Butler subsequently named the species to which he referred this fossil *Palæontina Oolitica*, and described and figured it in his "Lepidoptera Exotica." I quote his description—"Though a British insect, this species belongs to a group so completely tropical that I do not hesitate to describe and figure it in the present work; its nearest allies are the genera *Calligo*, *Dasyophthalma*, and *Brassolis*, all three essentially tropical American genera. *P. Oolitica* is especially interesting as being the oldest fossil butterfly yet discovered; the most ancient previously known to science having been found in the Cretaceous series (white sandstone of Aix la Chapelle)" (this is an error of Mr. Butler's; the insect was found at Aix in Provence, in strata belonging to the Upper Eocene period) "whilst the bulk of the known species are from the lower Miocene beds of Croatia; it is also interesting as belonging to the highest family of butterflies and to a sub-family intermediate in character between two others, viz., the *Satyridæ* and *Nymphali*, whilst the more recently discovered fossils are referable, with one exception, to the two latter groups. The nervures appear to have been impregnated with iron, which will partly account for their well defined condition."

Mr. Scudder, who states that he carefully examined the original fossil, considers Mr. Butler to be in error in referring this wing to a *Lepidopterous* insect, and is of opinion that it should be considered *Homopterous* rather than *Lepidopterous*, and allied to *Cicada*. Mr. Scudder's opinion is presumedly formed from a careful study of the neuration of the wing and a comparison of the neurations of *Lepidoptera* with those of *Cicada*. Mr. Scudder's views on the subject are given at length in his "Fossil Butterflies," pages 90-95, but time will not permit me to quote them. Mr. Butler has himself directed my attention to the neuration of this wing, and also to that of some of the *Cicadæ* in the British Museum Collection, and, from a comparison of the wing with these insects, I am inclined to agree with Mr. Butler, who in his view is supported by Professor Westwood and Mr. Bates. It will be observed that Mr. Butler refers this wing to a butterfly of a tropical species, which is quite consistent with the general character of the large *Neuropterous* wings and *Bupresti-*

dean elytra of the Stonefield slate, which is stated by Professor Westwood to be "decidedly tropical." Probably Mr. Scudder is somewhat prejudiced by the opinion which has, according to M. Preudhomme de Borre, always prevailed amongst Continental Naturalists, viz., that the order *Lepidoptera* was the last created, and that none existed prior to the Tertiary epoch. I believe that the same opinion is also held by such English entomologists as have given the subject their attention. Sir John Lubbock, F.R.S., in his "Origin and Metamorphoses of Insects," observes, "Well characterized *Orthoptera* and *Neuroptera* occur as early as the Devonian strata; *Coleoptera* in the coal measures; *Hymenoptera*, *Hemiptera* and *Diptera* in the Jurassic; *Lepidoptera*, on the contrary, *not until the Tertiary*." M. Oustalet appears to form an exception to Continental Naturalists, in his view of the probable date of the apparition of the *Lepidoptera* on the Geological Horizon. At page 26 of his "Recherches sur les insectes fossiles," he gives the Upper Oolite (Epoque de Purbeck) as the period during which this order first appeared. Since the date of the discovery of *P. Oolitica*, another fossil butterfly is stated to have been discovered in the Stonesfield slate of Oxford. This second specimen is said to be in the possession of Mr. Parker, of Oxford, but has not yet, I believe, been figured or described.

LIAS AND RHŒTICS.

The Lias, including therein the Rhœtic series, is in *this country* the lowest formation of the secondary rocks in which fossil insects have been detected. It is of great extent in this country and generally rich in remains. It consists of Argillaceous limestones, shell, marls, and clays, and is in England divided into three formations, viz., the *Upper*, *Middle*, and *Lower*, and is for the most part of marine origin. Sir Charles Lyell states that some members of the series, especially in the lowest part of it, have an estuarine character, and must have been formed within the influence of rivers. In some sections of this formation insect remains have been detected in such abundance that the beds containing them have, as in the Purbeck strata, been called the

"Insect Limestones." The remains of insects have been found chiefly in the lower division of this formation in Gloucestershire, Worcestershire, Warwickshire, Somersetshire, and on the borders of Monmouthshire, and a few in Yorkshire. They are generally in a much more fragmentary condition than those from the Purbecks, and, although abundant, are less common than in the latter formation. Mr. Brodie states that he first discovered these interesting fossils in the immediate neighbourhood of Gloucester. He also states that some of the beds of limestone in the lowest division of the Lias, in the vale of Gloucester, abound in insects, and that beautiful specimens of insect remains, chiefly elytra and wings, have been found in the Upper Lias at Dumbleton and Alderton. In this locality (Dumbleton), which is about twelve miles north-east of Cheltenham, Mr. Brodie obtained from the Upper Lias shales one nearly perfect *Neuropterous* insect, of which Professor Westwood says: "It possesses an arrangement of the wing veins differing from that of any English species, and also from any foreign species known to me, but it comes nearest to the small *Libellulæ* forming the genus *Diplax.* In the Upper and Middle portions of the Lower Lias, which are extensively developed in the neighbourhood of Gloucester and Cheltenham, traces of insects are said to be exceedingly scarce, but at Wainlode Cliff, on the banks of the Severn, near Gloucester, the insect limestone has produced, according to Mr. Brodie, remains of several genera of *Coleoptera,* which are not very rare; and a few wings not unlike those of the genus *Tipula.* With these were found abdomens of some insects, and larvæ, apparently of the gnat tribe. In insect limestone, to the south-west of Combe Hill, not far from the last mentioned locality, Mr. Brodie obtained a great number and variety of insect remains, consisting chiefly of the elytra of *Coleoptera,* and a few imperfect, but large, wings of *Libellulæ.*

At Apperley, near Wainlode Cliff, the remains of insects have been found in plenty, and many small slabs, three or four inches square, exhibiting several elytra and wings, and a few small beetles. From the insect limestone near the village of Hasfield, Gloucester, various elytra of *Coleoptera* and a few beetles have been obtained. The same formation in the neighbourhood of Forthampton, near Tewkesbury, has also furnished insect remains similar to those found in the localities before mentioned. At Strensham, two miles from Dafford Station, and nine from Evesham, from a bed of insect limestone at the bottom of a large quarry, numerous remains of insects have been obtained. Amongst them was found part of the abdomen of a gigantic species of *Libellula*, which Mr. Brodie named *Libellula Hopei*. In the neighbourhood of Evesham the insect limsetone has produced numerous remains of insects, the wings and elytra of many of which are said to be beautifully preserved. In the lower division of the Lias, in this neighbourhood, Mr. H. E. Strickland discovered small elytra of *Coleoptera* and portions of the wings of *Libellula*. "In the County of Warwickshire," says Mr. Brodie, "there is a large extension of the lower Lias in the neighbourhood of Bidford and Binton. The quarries thereabouts afford some of the finest sections in this part of the series. The insects are not confined to one or two comparatively thin seams of limestone, but occur in several distinct beds, the whole being developed to a much greater extent than in any part of Gloucestershire hitherto examined." From one quarry near Bidford Mr. Brodie obtained a small species of the family *Gryllidæ*, which he named *Gryllus Bucklandi*, in honour of Professor Buckland. In some of the strata in this neighbourhood (Bidford) the wings of *Libellula* were obtained not uncommonly, particularly at a place called the Nook, where a beautiful specimen was found, which has been described and figured by Mr. Strickland. Mr. E. T. Higgins obtained from the Lower Lias or the Rhœtics, in the southern parts of Gloucestershire and the adjoining county of Somersetshire, in the neighbourhood of Bristol, numerous remains of insects. From Aust, near Bristol, and from Sudbury on the Monmouthshire side of the Severn, about three miles from Chepstow, the insect limestone and the landscape stone have afforded a quantity of remains. In some slabs the insects were found embedded together in masses. In one slab Mr. Higgins is said to have detected as many as thirty small beetles. From the frequency of such delicate creatures as insects in the "Landscape Stone," and in another band of limestone only a few feet higher, some of which are said to be beautifully preserved, and could not have been long subject to the action of the waves, Mr. Brodie supposes that this part of the Lias may have been formed in an estuary, which received the waters of some neighbouring coasts, and which brought down the remains of insects and plants. The *Coleoptera* appear to have been abundant in the Lias, for out of some three hundred specimens of insects, or parts of specimens, from this formation, examined by Professor Westwood, more than one-third were referable to this order, and comprised the families *Buprestidæ*, *Elateridæ*, *Curculionidæ*, *Chrysomelidæ*, *Carabidæ*, *Telephoridæ*, &c. Most of the species appear to have been very minute, "never equalling," observes Mr. Westwood, "in size those from the Stonefield Slate."

The other orders represented in this formation are the *Orthoptera*, the *Neuroptera*, the *Hemiptera*, and the *Diptera*; the minute *Diptera* and *Trichoptera* of the Purbecks are said by Westwood to be absent. The remains of *Orthoptera* include *Gryllidæ* and *Blattidæ*, the *Hemiptera* include *Cicada* and *Cimex*, and the *Neuroptera*, *Libellula*, *Agrion*, *Orthophlebia*, *Hemerobius*, *Œshna*, *Chauliodes*, and *Ephemera*. Among these various families we have terrestial and fluviatile genera, which include omniverous, herbaceous, and predaceous species. A great number of the families and genera found in the Lias are common both to it and the Purbecks. The following Lias insects, however, have not, I believe, been found in the Purbecks, viz., *Gyrinus*, *Laccophilus*, *Berosus*, *Melolontha*, *Telephoridæ*, *Gryllidæ*, *Agrion*, *Hemerobius*, *Ephemera* and *Asilus*. Although, as a rule, the remains of insects from this formation are very imperfect and fragmentary, the detached wings of many *Neuropterous* insects are said to be preserved in the greatest perfection, and have the nervures of the wings beautifully defined, and retaining the original colour, or rather the spots. The size of the insects, judging from the remains, appears to have been usually small and indicative, if taken alone, of a temperate climate. Mr. Brodie observes that, "with some rare exceptions (viz.), the gigantic *Libellulidæ*, *Termitidæ*, and larger *Chanliodes*, these insects seem to have belonged to a temperate climate, and thus they offer, as in the Purbeck series, a remarkable distinction in the contemporary forms of animal life, which, both in the Purbecks and Lias, are chiefly referable to extinct genera, and were most probably natives of warm latitudes. In one respect, however, they differ from the Purbeck insects, since they are less closely allied to European forms, and more nearly to those which now inhabit North America." It may be observed that all the numerous remains of insects from this formation have, with the exception of a few specimens from the upper division, been obtained from the *lowest* division of the Lias, or from the Rhœtic series, between the Lias and the Trias. These remains are very numerous, but the majority of them were in such a fragmentary condition that it has been impossible, even for those who have devoted their especial attention to the subject, to make out the species to which they belonged. About fifty-six species, however, are stated to have been determined, which are distributed amongst five orders, as follows, viz. :—

	Coleoptera...	29	species.
	Meuroptera	12	„
	Orthoptera	7	„
	Hemiptera...	9	„
(supposed)	Diptera	2	„

No traces of *Lepidoptera* or *Hymenoptera* have been met with, and the remains which have been referred to the *Diptera* are very doubtful. In concluding this part of my paper, I would observe that whilst fully appreciating the value of the learning, the industry, and the research, of the Geologist, which have been the means of bringing to light these interesting relics of a former world, the value of the special knowledge and experience of the Entomologist, must not be forgotten; and it should be borne in mind that the learning and skill of Professor Westwood, an Entomologist of world-wide reputation, was, undoubtedly, of the greatest assistance in the determination of the species, or of the orders, to which they belonged, of many of the specimens obtained from the Purbecks and the Lias.

FOREIGN STRATA.

EUROPE.

The Rocks of this period on the Continent, with theexception of the Solenhofen slate, and the Lias of the Swiss Alps, have not, as before stated, as yet produced any quantity of insect remains.

CRETACEOUS.

The Cretaceous system has as yet produced but very few fossil insects. Professor Pictet alludes to some indistinct impression of insects in the Schists of Glaris. Dr. Geinitz has called attention to the remains of perforated wood in the upper and lower greensand, of Saxony, which appear to him to be evidence of the existence of Longicorn beetles during this epoch. He has referred the insects, which he believed to have made these perforations, to the *Cerambycidæ.* Professor Pictet further says that M. Desmoulins found certain elytra of *Coleoptera* in the chalk marl of the mountain of St Catherine, near Rouen.

UPPER OOLITE.

SOLENHOFEN SLATE.

The most celebrated formation of this period from which fossil insects have been obtained in any number, is that of the well known lithographic stone of Solenhofen in Bavaria (before referred to), belonging to one of the upper divisions of the Oolite. Of this formation Sir Charles Lyell observes that, "although the number of *testacea* in this slate is small and the plants few, and those all marine, Count Munster had determined no less than 237 species of fossils, including 26 species of insects. These insects, among which is a *Libellula,* or dragon fly, must have been blown out to sea, probably from the same land to which the flying lizards and other contemporaneous reptiles resorted." The oldest account of fossil insects from this formation is found in

Schroter's Lexicon, published in 1779. In a subsequent work Schroter figured a *Lepidopterous* insect, which Germar named *Sphinx Schrœteri.* In 1783 Esper refers to the discovery of a species of *Gryllus* in the Solenhofen Slate. In 1826 Van der Linden described a *Neuropterous* insect from Solenhofen as *Œschna Antiqua.* Reference to fossil insects from this locality is also made by M. Marcel de Serres in 1829, and Bronn, in 1835, enumerates two genera of *Coleoptera*, four of *Neuroptera*, two of *Hymenoptera*, and one of *Lepidoptera*, from the same locality. In 1839 Professor Germar published in the "Nova Acta" of the Leopoddine Academy, descriptions of 25 species from Solenhofen, including *Coleoptera*, *Orthoptera*, *Hymenoptera*, *Hemiptera*, *Lepidoptera*, and *Diptera*. Several species from this locality were also described (in 1814) by Count Munster, including a *Lepidopterous* insect, which he referred to the *Tineina*. In his "Fauna der Vorwelt" (Insekten and Spinnen), published in 1856, Dr. Giebel enumerates 26 species from this locality, including:—

Coleoptera...	2	species.
Orthoptera	4	,,
Neuroptera	12	,,
Hymenoptera	1	,,
Hemiptera...	4	,,
Lepidoptera	1	,,
Diptera	2	,,
	26	

Dr. Hagen, who has paid especial attention to the Solenhofen *Neuroptera*, describes 24 species in the tenth volume of Meyer's Palæontographica, published in 1862, and also gives a list of 37 species in the Royal collection in the Academy of Munich. In Vol. XV. of Meyer's Palæontographica, published in 1865, Dr. Hagen described and figured eight further species of *Neuroptera* from the Solenhofen formation. Of the 37 species of *Neuroptera* in the Munich collection, 27 are said by Dr. Hagan to be dragon flies, some of which belong to extinct genera, but others to such as now live in America and Australia. Dr. Hagan states that many of the fossil insects from this formation, preserved in the Munich collection, and the collection of Dr. Crantz, of Bonn, are in a splendid state of preservation. One-third of the entire collection are *Libellulæ*, another third consists of *Orthoptera* (including some gigantic *Locustæ*) and *Hemiptera* (especially gigantic species of *Belostoma*, *Pygolampas*, and *Nepa*), and the remaining third consists of *Coleoptera*, *Hymenoptera*, and *Diptera*. Out of 450 specimens of fossil insects in the Munich collection, 150 are *Neuroptera*, and out of these 136 belong to the *Odonata*. Dr. Hagen says that of those not *Odonata*, six only (comprising four species) belong to the *Neuroptera* as restricted by Erichson, viz., one species of *Corydalis*, one *Chrysopa*, a large *Apochrysa*, and a beautiful *Nymphes*. The last two genera, which do not seem very remote from *Chrysopa*, are now found only in the Southern Hemisphere. *Nymphes* is almost exclusively an Australian genus. The *Odonata*, continues Dr. Hagen, comprise the following, viz.:—

Libellulina	4 species.
Æschnina	1 ,,
Gomphina	7 ,,
Calopterygina	11 ,,
Agrioniana	4 ,,

The *Gomphidæ* are said to belong principally to species which come near the genera *Petalia*, *Phenes*, and *Petalura*, of which a few species occur at the present day in Chili and Australia. The fossil *Gomphina* of Solenhofen are generally very large, and some are truly gigantic, 4 inches in length, with an expanse of wings of 7½ inches. Of the *Calopterygina*, the group *Heterophelbia* contains some of the most gigantic *Neuroptera*, two of them belong to the largest known *Odonata*, having an expanse of wing of 7½-8 inches, and bodies 3¼-4 inches in length. According to M. Oustalet, a number of specimens from Solenhofen, preserved in the Museum Tyler at Haarlem, have recently been described by Herr Weyenbergh, jun., who has distinguished 74 species, as follows :—

Of the Coleoptera	26 species.
,, Diptera	5 ,,
,, Orthoptera	10 ,,
,, Neuroptera	42 ,,
,, Lepidoptera	1 ,,
	74

From a study of the fossil insects from this formation and a comparison of them with those of England, Dr. Hagen has drawn two conclusions, viz. :—*Firstly*, That the two fauna are extremely closely allied, and that possibly some species occur in both formations. *Secondly*, That the fauna of the English and Bavarian strata are not only quite distinct from the existing fauna, but also from those of Aix, of the Rhenish peat deposit, Brown Coal of the Rhine, of Œningen and Radoboj, and from that of Amber, differing not only in species but in genera.

LIAS.

From the lower marls of the Lias, at Schambelen, in the Canton of Aagau, in Switzerland, about 2,000 specimens of fossil insects, comprising 143 species, have been obtained by Professor Heer. With the exception of one insect from the Carboniferous system, and five from the Trias, these are the most ancient insects of Switzerland. Dr. Heer considers that Schambelen is the only locality on the Continent in which so large a number of primæval insects have been preserved to our time. The 143 species are distributed as follows :—

Coleoptera...	116	species.
Orthoptera	7	,,
Neuroptera	7	,,
Hemiptera	12	,,
Hymenoptera	1	,,
	143	

No *Lepidoptera* or *Diptera* have as yet been discovered, and the *Hymenoptera* are represented only by a single small wing. The abundance of the *Coleoptera* may be due to the circumstance of their hard elytra having been better adapted for preservation, than the soft wings of most other insects ; but as the delicate membranous wings of the *Termites* have been preserved, there can be but little doubt that if the *Diptera* and *Lepidoptera* had existed at this period, some traces of them would have been discovered. In this deposit the order *Coleoptera* is represented by more than four times as many species as all the other orders put together. The species are referable to some sixteen families, including *Carabidæ*, *Cryptophagidæ*, *Byrrhidæ*, *Hydrophilidæ*, *Buprestidæ*, *Elateridæ*, *Rhyncophora*, &c. Certain orders are entirely unrepresented, including the *Longicornes*, *Coccinellæ* (Ladybirds), the *Xylophagi*, *Melasomata* and *Brachelytra*. The *Lamellicornes* and *Chrysomelinæ* are poorly represented. The presence, in large numbers, of those beetles whose larvæ are wood feeders, and who in their perfect state are usually found on or under the bark of trees, is evidence of the existence of woods or forests during this period. The presence of several genera of fungus beetles implies the existence of fungi, but as yet none have been discovered. Of the *Byrrhidæ* four species have been found in this formation; three of them, *Byrrhidium*, *Arenatum*, *B. Morio*, and *B. Troglodytes*, are among the most abundant insects at Schambelen, and as they are all moss feeders, Professor Heer supposes that the ground and trunks of the trees were more or less covered with mosses, although no remains of these plants have been preserved. The leaf-eating beetles are represented by, amongst other species, two of the family *Chrysomelidæ*. The presence of a small Coprophagous beetle (*Aphodiites protogæus*), so closely resembling the *Aphodii* which now live on the excrements of cattle, would lead to the presumption of the existence at that time of mammalia in Switzerland. All the before-named beetles are herbivarous species. Of the carnivorous beetles we have 29 species, including *Telephoridæ* and *Carabidæ*. The water beetles are represented by some 20 species. The *Orthoptera* comprise three species of cockroaches, three grasshoppers, and one ear-wig; and the *Neuroptera* are represented by 6 species of *Termites* (or white ants) and one dragon fly (*Libellulidæ*), *Œschna Hageni*, which is larger than any living species. It may be safely inferred from the richness of the insect fauna that the land must have been of considerable extent. The Aquatic insects, especially, afford evidence of this fact. Their numbers are so great as to imply the presence of a river or large lake, the existence of which in a small island is improbable. Many of the insects are of large size, but the majority are small, some even smaller than their smallest living relatives of the present day, as is also the case with the insects of the English Lias. When the conditions of climate are favourable to a luxuriant growth of plants and insects, the larger forms of the insect class are developed, as in tropical America and Asia, but side by side with these large species thousands of minute species are to be found. It may be inferred from the general smallness of the Liassic insects, both from Continental and English strata, that insect life was not at this period so luxuriant, or capable of producing such large forms as the tropical world of the present day. The numerical proportions of the families furnish evidence of a warm climate. The *Buprestidæ* are very numerously represented. Of the *Termites* eight tropical forms have been discovered, and the cockroaches appear, says Heer, more closely allied to those now inhabiting the Torrid Zone than to those of Switzerland at the present day.

The only other record which I have been able to find of the occurrence of insects in this formation on the Continent, is contained in the second volume of Bronn's * "Lethea Geognostica." At page 210 of that work it is stated that Count Münster detected some wings of insects in the Lias of Bayreuth.

TRIAS, OR UPPER NEW RED SANDSTONE.

The Trias or Triple Group is separable on the Continent into three distinct formations, called the "Keuper," the "Muschelkalk," and the "Bunter Sandstein." The "*Muschelkalk*," or *Calcaire Coquillier* of French geologists, is wanting in this country. As has before been stated, no traces of insects have as yet been found in any part of this formation in the United Kingdom, and until recently none had been recorded from strata of this period on the Continent. M. Oustalet, in the first part of his "Recherches sur les insectes fossiles," published in 1871, says "Les insectes fossiles manquent jusqu'à présent dans le terrain pénéen et dans le Trias." Since this was written, however, five specimens appear to have been discovered in this formation. In Mr. Heywood's edition of Heer's "Urwelt der Schweiz" (Primeval Switzerland), it is stated that "in the Keuper Marls of the Rutihard, Professor Heer has vainly sought for insects, but in the Black Shales of Vadutz he has found two species of beetles, viz.:—*Glaphyroptera Pterophylli* and *Curculionites prodromus*." Further on in the same work it is stated, "In the Bunter Sanstein of Trelitz and Salzmunde three more have been found, *Legnophora Girardi*, *Chauliodites*, *Picteti*, and *Chauliodites Zinckeni*."

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* Jahrb, 1835, s. 333, and Lethea Geognostica, vol. i., p. 210.

AMERICA.

TRIAS.

In the Geological Magazine for May, 1868, Mr. Scudder mentions one *Coleopterous* insect from the Trias of the North American Continent. This is, at present, the only fossil insect recorded from the secondary rocks of America. With the "Bunter Sandstein" we arrive at the lowest stratum of the secondary period, and I am consequently able to bring this paper to a conclusion. Before this paper is published, lists of the families, genera, and species of the insects detected in the secondary formations will be added to it, by reference to which the fullest information respecting the "Insect Fauna of the Secondary Period" will be obtained.

The PRESIDENT, Mr. G. D. Sawyer, said he was sure it would be the pleasure of the Meeting, as it was his, to pass a vote of thanks to their essayist for the very exhaustive paper he had placed before them. He was hopeful Mr. Goss would not misunderstand a remark he made on the reading of the previous paper, so as to think he (the Chairman) was impatient for him to draw deductions when he had not yet examined the evidence sufficiently to arrive at his deductions.

He took it that those who were close observers would be of the very greatest importance to them in the investigation of scientific matters, and that if they would give them the results of their close investigations, the time would come when by a comparison of those investigations and of the evidence thus obtained, they would be able to draw deductions which might be still more interesting than the facts which had been put before them that night. He himself had been greatly interesting in what they had heard. It had not been to him at all dry, but he had been a little disappointed at the barrenness of the upper cretaceous white chalk period which we enjoyed so much round here, that we could not do anything to illustrate the subject spoken about; but he did not despair that the remains of insects would be found in that upper cretaceous period for Great Britain. It would have struck them, as it did him, that the investigation of the subject of insect remains threw a light upon other things that they found in very low periods, such as the lower lias; they could tell what must have been the surrounding state of things as to the woods, mosses, and fungi, and so on by finding that insects which must have existed in those days were obtained, and that they remained even after the objects on which they had fed had dissappeared entirely. They could never tell in investigating scientific matters what light would be thrown on what they were about: there was very great encouragement, therefore, to persevere in close observation, and the record of observations carefully taken was of very great importance; and that seemed to have been the *forte* of their worthy essayist. On their behalf, therefore, he begged to tender him their hearty thanks for the excellent paper which he had read.

Mr. **Farr** asked the lecturer if he had ever examined any of the deep chalk pits in this neighbourhood.

Mr. Goss observed that the chalk had not produced anything, and he thought it had been pretty well worked. He believed a geologist would say there was hardly any strata which was better worked for fossils of one sort or another than chalk.

The CHAIRMAN thought Mr. Farr would remember that the objects discovered in the chalk were marine.

Mr. GOSS said it was quite exceptional to find insect remains in marine formations at all. They might be blown into the sea, or by a strong river washed out in currents into the sea, but as a rule they did not expect to find them in marine deposits. One of the most important things which they drew from the study of insect remains was what the climate of a former period was, and they might arrive at some knowledge on the subject by considering the proportion existing between the carnivorous beetles and the vegetable beetles, because it was well known at the present day there was a certain ratio existing between those two groups, which varied according as they come nearer to the equator or departed further from it. The nearer they came to the equator the vegetable beetle got much commoner, and the carnivorous much more rare. A great advantage was derived from the study of fossil insects, and that was they could arrive at some idea as to the climate in former times—the climate of Europe, for instance, in the Miocene period was undoubtedly tropical—and thus they could do something towards increasing the knowledge of the past.

Mr. PENLEY said the lecturer had not made any mention of the coal formation.

Mr. GOSS replied that it was because his paper dealt with the tertiary and secondary periods only. That subject would be for a third paper.

The meeting then terminated.

JUNE 28TH.

MICROSCOPICAL MEETING.

THE STAINING OF VEGETABLE TISSUES.

The PRESIDENT, Mr. G. D. Sawyer, read the following short paper, contributed by the other hon. secretary (Mr. T. W. Wonfor)—explanatory of the objects which were that night to be exhibited under the microscopes :—

Mr. T. CURTEIS, of 244, High Holborn, one of our honorary members, has sent down for the Society's cabinet some slides to illustrate the new process of staining vegetable tissues described in a paper read before the Quekett Society recently, a description of which method will be published in the next number of the journal of that Society.

All microscopists know there are great advantages in being able either to inject or stain animal tissues, because by these methods of preparation, structures not readily visible or easily made out without such preparation are brought out with great distinctness and clearness. Processes for staining vegetable tissues have been adopted by many microscopists, and one of our members, Dr. Halifax, some fourteen years since, carried on a series of experiments in staining vegetable tissues by placing living portions of plants in solutions of various kinds, and, after some time, varying from a few hours to days, making sections of the various parts, such as stem, leaves, and flowers, and tracing the presence of the staining material in the several parts. The present process appears to depend on the use of the aniline dyes, which, in the case of the diatoms, seem to have the property of attacking and fixing the endochrome, thus bringing into greater contrast the silicious valves.

Besides the slide of *Licmophora*, mounted by Topping, Mr. Curteis has been able, through the kindness of Mr. Tatem, of Reading, to send two slides for the cabinet, further illustrating methods of mounting the delicate diatomaceæ on the weed. In one case the diatoms are put up in saturated salts—in this case the green colour of the endochrome is preserved. In the other the specimens are stained with aniline dye, and mounted in Canada balsam. Unlike the slide mounted by Topping, the endochrome only is attacked. It will be found from the paper read before the Quekett that the specimens are first stained with one colour, which attacks certain parts, and then are dipped in another solution, which attacks other parts, so producing something of the effect of a part of an organ injected with two different colours.

After a few conversational remarks on the paper read by the President, by Mr. J. E. Haselwood and Mr. R. Glaisyer, the librarian, a letter was read from Mr. C. F. Dennet, having reference to the statement made by Major Hallett, in his paper on "Cereals," that grain would not germinate after ten years.

In Payson Town, Utah Territory, he said, are six mounds. Excavations were made last year in some of these, which led to the discovery of the remains of a people, supposed to be the tribe of Nephites referred to in the Book of Mormon, who lived 1,400 years ago.

On opening one of the graves, about three pints of wheat kernels were found, the bulk of which quickly perished on exposure to the air, but a few kernels in the centre of the heap looked bright, and retained their freshness. These were carefully preserved, and last spring (1876) were planted and grew well, though the field insects seemed determined to devour it. Four-and-a-half pounds of heads were raised from these few grains—the produce, which is of the club variety, having very long heads and holding very large grains, being unlike any other cultivated in that country. Specimens of the wheat so raised were exhibited at the meeting.

JULY 6TH.

THE ANNUAL EXCURSION.

The most pleasant event of the year in connection with the Society was participated in by about forty of its members and several friends. Favoured by weather, which was in every respect most suitable, the party spent a delightful day, thoroughly enjoying the trip, which was not easily to be forgotten. It had been decided to visit Pevensey, Hurstmonceux, and Hailsham, places which were visited by the Society some twenty years ago. The party left Brighton in two saloon carriages at 11.35 in the morning, and were met at Pevensey by three brakes, drawn up at the hotel close by. After a slight, though, nevertheless, acceptable lunch, they mounted the vehicles, and were driven to the ancient and ivy-covered ruins of the Castle. On entering the grounds surrounding the Castle, the visitors seated themselves on the grass, and listened attentively to the following paper by Mr. G. D. Sawyer, President of the Society, on

PEVENSEY CASTLE.

Gentlemen, fellow members, and friends of the Brighton and Sussex Natural History Society,—Your Committee, in the exercise, as I think, of a wise discretion, have usually arranged that during our annual excursion in each year we should be invited to visit one or more of the interesting ancient ruins existing so plentifully in our county. On this occasion they have selected Pevensey Castle, a spot second to none in the interest it must excite in the minds of all imbued with the slightest love of archæology. I feel sure that you will desire no apology from me for asking you to listen for a very short time to a few facts and opinions connected with this venerable ruin. True, they are quite accessible to any of you who choose to search the volumes issued by our excellent Archæological Society of Sussex, and some other books which I have consulted; but you may not have had time to refer to them. I have merely made a selection out of a large mass of matter at disposal, as I greatly desired not to tire your patience, and I must ask your forbearance if, in my anxiety to avoid doing so, I have omitted some interesting matters that you may think I ought to have commented upon. Pevensey is one of the most thoroughly historical places in Sussex, although now only a village instead of a flourishing port and town. In the British and Roman periods, and long afterwards, the sea came up the river Ashbourne to where the Castle now stands, and still higher; and so good was the port for landing, that Julius Cæsar, according to Professor Airey, landed here on his first invasion of Britain. I am aware that this is disputed by other writers, but I think the balance of evidence is in favour of this belief. Also, notwithstanding similar controversy existing on the subject, I think it is amply proved that this is the site on which the Romans built the regularly fortified town of Anderida, called also by the Britons Cær Andred, and by the Saxons Andredceaster. When the Saxons came to this district, under Ella, they took Anderida, and totally exterminated the inhabitants. It was afterwards rebuilt, and became again a place of great importance. The Saxons also called it Peofnesea—the Normans Pevensell, since converted into Pevensey; and in the dialect of the country it is now known as Pemsey.

It is clear that the Romans neglected in this instance the rectangular arrangement so usual in Roman and Castra, followed the line of the rising ground, thus producing the irregular, oval, and island-like form of the enclosure. At this time the southern and eastern sides doubtless occupied a sort of low cliff, washed at every tide by the waters of the ocean, or, at least, by a considerable arm of the sea. A good map of the Castle will be found at page 274 in Vol. VI. of the Sussex Archæological Society's collections. It was prepared by Mr. William Figg, F.S.A., at the time of making the excavations in the Castle in conjunction with the late Mark Antony Lower. The walls coloured red shew the Roman portions, while those given in grey represent the mediæval additions. The space inclosed by the walls is said to be about twelve acres. The material of the walls is flint, with sea-sand mortar of great strength. The joints of the masonry are pointed with mortar, having for one of its ingredients pounded tile, which imparts to it that red tint so characteristic of Roman work. From some excavations carried on in the year 1710, for the purpose of supplying the town of Pevensey with water from the moat of the interior (or mediæval) castle, by a channel beneath the Roman walls, it was found that the latter, which were ten feet thick, had rested upon a foundation consisting of piles planked over with slabs of an extraordinary substance. Notwithstanding the length of time they had laid in the earth, the timbers exhibited no symptom of decay. The external facing-stones at the bottom of the walls have everywhere been removed for building purposes. For ages Pevensey Castle served as a quarry for the neighbouring country; and it is only within the last eighteen or twenty years that this almost sacrilegious abuse has been discontinued. Nature in general deals kindly and tenderly with the works of man, but, alas! how few architectural remains can be said to have been *Religione patrum multos servata per annos!* Certainly at Pevensey the ravages of time have been slight compared with those wrought by the hands of man.

The great entrance, or Decuman Gate, with its strong weather-worn flanking towers, is the first object that strikes the eye of the visitor on his approach to the ruins from the west. Leaving this gateway, and pursuing the external circuit of the walls in a northerly direction, we pass three other towers of similar character. Beyond the third tower, the walls take a north-easterly direction, having no towers. A little distance beyond this the wall has fallen outwards, and lies in massive fragments, now overgrown with trees. Another one hundred and fifty feet brings us to one of the most perfectly preserved towers of the series. This originally measured thirty-two feet in height, but an addition made to it in the Norman period raised it to the altitude of fifty-feet. This Norman addition is as base in its masonry as the Roman portion is excellent. There can be little doubt that this was made use of as the watch tower. Still following the circuit of the walls by the high road, passing another tower, and making a sudden curve to the south-east, we arrive at a tower which must have been much dilapidated at an early period, and has undergone extensive repairs, very neatly carried out. A few yards more bring us to a postern-gate, communicating with a foot-path crossing the inner area and with the High Street of the town of Pevensey. Just southward of this is another tower, at one hundred and twenty feet from which the Roman work forms a junction with the mediæval castle. This may be properly called mediæval in preference to Norman, because, although there is no doubt of a Norman fortress having existed upon the spot, a considerable portion of the existing remains point to a date long subsequent to what is recognised as the Norman period, probably to the days of the earlier Edwards. This mediæval work is curiously engrafted upon the Roman. There are five towers of the subsequent era, two in ruins, flanking the great gateway, which looks nearly due west towards the principal entrance of the Roman work, from which it is distant three hundred and fifty feet. The towers are constructed of what is locally called E'bourne stone, and they have immense loop-holes.

The north-western tower is supposed to have been the residence of the governor. This Norman and post-Norman work forms an independent castle complete in all its parts, with the enceinte, moat, and other usual accessories of a castle of the middle ages, albeit upon a small scale. The remains of its keep are still recognisable on the eastern side of the enclosure. The interval going west between the mediæval castle and the Roman gateway, at which our survey commenced, is precipitous ground, faces the sea (at a distance of about a mile), and retains upon the surface few traces of ancient masonry of any kind. Whoever but for one moment contemplates this structure, with its solid towers and walls ten or twelve feet thick (presenting much the same appearance

where they remain standing as
of Constantine) and thirty-eigh
a-mile in circumference, will per
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the twelfth century it was besieg
in 1265 by Simon de Montfort a
troubles, we come to the year 13
Richard II. against a large fo
counties of Kent, Surrey, and
bravely conducted by Lady Pelh
who was then away in the north
walls Edmund Duke of York,
King James the First of Scotland
as prisoners. Again omitting mu

rapidly close these few hastily-gathered and imperfectly-arranged remarks, merely glancing at the fact that there is the foolish tradition (so usual with respect to castles near to religious establishments) that there was a subterraneous passage connecting this castle with the ancient house in Westham called Priesthawes, between two and three miles distant, and that the rustic inhabitants of the neighbourhood were considerably disappointed when the late Mark Antony Lower proved, by careful excavation, that the "passage," so called, which an old inhabitant assured him he had seen at a few perches distant from the south-west angle of the great gateway, was merely a large drain. "'Why, sir,' said one of them to me (says Mr. Lower), 'so this here subterr*ee*nous passage as we've so long heerd an turns out to be nothin *but a gurt dreen.*'"

The party then scrambled over and about the ruins of the Castle, the interior of which had been taken possession of by about two hundred and fifty children belonging to the Eastbourne National Schools. The large well in the centre of the Castle was an object of some interest. It was stated by the President that an attempt had been made to clean it out, and that after getting to a depth of forty feet the work was deemed too difficult to be proceeded with; and it was mentioned by Mr. Alderman Cox that a number of wolves' heads were discovered amongst the *débris* in the well. In the garden belonging to the house near the Castle were several of the catapults—large round pieces of rock—which were also found in the well. Resuming their seats in the vehicles, the party drove to Hurstmonceux, passing through the village of Wartling, and pausing a short time to inspect the interior of the church, which contains several beautiful monuments of white marble, erected to the memory of members of the Curteis family, to whom the Castle of Hurstmonceux belongs. Proceeding on their journey to the Castle, along a road shaded by trees on either side, the vehicles gradually approached this remarkable pile of dismantled buildings, the property of Mr. Herbert Mascall Curteis, of Windmill Hill Place, whose father

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Kent, Surrey, and Sussex, an
miles long by 30 miles broad—
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locally corrupted into Horsemouncez; but *hurst* has changed into *horse* in other instances, as Horsebridge and Horseye in the neighbourhood—and as far back as the time of Henry VIII. it was spelt as now pronounced. The manor remained in the hands of the descendants of this Waleran de Herst till the beginning of the last century. It is thought that a manor house stood somewhere on the site previous to the erection of the castle itself, as some Spanish chestnut trees to the west of the castle seem older than that building, and antiquarians think they can trace portions of this more ancient manor house in parts of the present building.

With John de Monceux, who died in the reign of Edward II., died the last of that name who held possession of the estate, and it then passed into the family of the de Fienes, with whom it remained till Queen Anne's reign. A descendant of John de Fienes, Sir William, died in 1405, and was buried in the Parish Church, under a monumental slab adorned with a brass, still to be seen in the church. In 1440, Sir Roger De Fynes, one of the heroes of Agincourt, erected the present building, at a cost which was then enormous, but which is very inconsiderable now, £3,800. It is a splendid instance of early brick building, and was considered the largest private house in the kingdom. Sir Roger enlarged the park by adding 600 acres to the domain, and added to the castle an accessory very rare in Sussex, a heronry, which still exists. All round it ran a moat, and entrance to the castle was afforded by a drawbridge. For the convenience of water to the moat the castle has been placed in a very low situation, and beauty of view, or even healthfulness of site, seems to have been quite left out of sight by its projector. The bricks were probably made by Flemish workmen. They are very firm in texture and uniform in quality, and still stand, notwithstanding their exposure for more than four centuries to the weather and the erosive influence of the sea air, where violence has not wantonly injured them, without flaw or crack. Noble avenues of chestnut trees, mingled with a few oaks and beeches, in ancient times led up to the castle in several

directions. Only a few pictur
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To the south rises the noble
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of Anne of Cleves, he, in com
and Lord Mountjoye, headed th

meet the Queen expectant. But he was an unfortunate youth. The atmosphere he had breathed at Hurstmonceux was corrupting in its evil influence, and he met, through a foolish frolic, a tragical end. Trespassing with some riotous companions for venison in a neighbour's park, an affray took place, in which a gamekeeper was killed. Lord Dacre and three of his companions were put to death for the murder.

The estate afterwards passed, through this unfortunate nobleman's sister, Margaret, into the Lennard family, with whom it remained till the time of Thomas Lord Dacre, who was made Earl of Sussex by Charles II. He followed a fashion which was now beginning to prevail, and put sashes into the windows of the east side. He had the misfortune to come very young to the dissipated court of Charles II. (his father having been one of that small but noble band of peers who gave his voice against the trial of the King). He received the questionable honour of becoming the King's son-in-law, through his marriage with Lady Ann Fitzroy. He became very fond of gambling, and his extravagance was reckless. He must have spent a large sum on the alterations of Hurstmonceux. He put oak wainscoting upon the walls in place of the original tapestry, and the magic chisel of Grinling Gibbons added rich adornment to it. His extravagance obliged him, however, to sell the estate, and thus, in 1708, for the first time, it changed owners by purchase. It then became the property of Councillor Naylor. His successor was his relative, Dr. Hare, Bishop of Chichester, who left the castle to his son, Francis Naylor. In 1775 it came to his half-brother the Rev. Robert Hare. The building was then in a state of considerable unrepair, and Mr. Samuel Wyatt, the architect who spoiled Windsor Castle and several Cathedrals, surveyed it, and advised that it was expedient to demolish the interior and employ the materials in building new walls to the Mansion in the west of the Park. Unhappily, this was done, and what we see to-day is only the shell of the structure—the remains of a magnificent pile needlessly destroyed.

For, passing over the frail makeshift for the ancient draw bridge and entering through the wicket gate, by the side of which in former times a leathern black jack, well replenished with ale, used always to stand, we see a few shattered walls, a few steps of a winding stairs, a broken arch or two, and ruined foundations overspreading the area, as all that now remains of what, but sixty-four years ago, was the most perfect example of a feudal lord's mansion in the south of England. The great hall, chapel, kitchen, and other rooms are still to be made out, but the grand gateway, with its two towers, eighty-four feet high, is the best of what now remains. The moat was partly drained and made into a pleasure garden in the reign of Queen Elizabeth. Over the porter's lodge is a chamber known as the Drummer's Hall. It is said that formerly loud spirit rappings were carried on there. The ghost drummer, a figure nine feet high, was occasionally seen, so runs the tradition, straddling along the battlements at a furious rate, and by his nightly tattoos kept the country round in a state of alarm. If time allowed, it would be interesting to quote at length from a lively letter of Horace Walpole's, in which he gives a graphic description of the castle as he saw it before its dismantling—the walls standing in their native *brickwood*, raised in an age which had not reached the luxury of whitewash, the porch and cloister so like Eton College, the delightful carvings by Gibbons, particularly two pheasants—the Virgin and seven long lean saints, ill done, in the windows—&c., as well as the account of his journey thither from Tunbridge Wells, how his woes increase, the roads bad beyond all badness, the night dark beyond all darkness, the guides frightened beyond all frightfulness. But time does not allow of all this. I can only refer you to Vols. IV., X., XIV., XVI., XVIII., XIX. of the "S. A. C.," Mr. M. A. Lower's "Sussex Contributions," and Horace Walpole's own correspondence. If we grieve that we can no longer look at the building as he saw it, it is, at least, a beautiful ruin, and time and nature,

> "Softening and concealing,
> And busy with a hand of healing,"

have given in these ivy-mantled walls a thing of beauty for our eyes. In 1807 it was bought by Mr. C. R. Kemp, who sold it in 1819 to Mr. J. Gillon, from whom it passed, by purchase, in 1846 to Mr. H. Barrett Curteis, the father of the present owner, Mr. Herbert Mascall Curteis.

Some time was spent in examining the peculiarities of the castle and the fine garden at the rear, in which several apple trees, planted a hundred years ago, still continue to bear fruit. Leaving the ruins, which are perfect in their beauty—if ruins can be thus described—the party drove to the heronry near the residence of the owner of the castle, where a grand panoramic view of the Weald of Sussex was obtained. The birds, however, were evidently on the wing, as only one or two were seen by some of the party, who had a good look at their enormous nests built in the top branches of some very tall trees. The vehicles were then driven at a rattling pace towards Hailsham, which was reached shortly after five o'clock.

THE DINNER.

An excellent dinner was served at the George Hotel by Mr. W. Hutchings, to whom great credit is due for the admirable repast he put upon the table. After the removal of the cloth, the PRESIDENT, who occupied the chair, spoke in high terms of the value of the Natural History Society, which had many things to recommend it. He referred to their scientific meetings in the Curator's room, where a vast amount of research, industry, and scientific knowledge was evinced by the members; and to the papers read during the last six months, two or three of which had been so good that they had been read at similar meetings in London. He rejoiced in the past work of the Society, and looked with confidence to the future. He was very anxious that some of the members who did not take a part in the meetings would read papers and come amongst them. They had a library which was filled with splendid books of reference, which would be invaluable to those who desired to add to their stores of knowledge. Having mentioned that he had had the honour of representing the Society at Croydon and Bradford, and that he would represent it at the forthcoming meeting of the British Association at Plymouth next month, the PRESIDENT proposed "Success to the Brighton Natural History Society," and resumed his seat amid applause.—The toast was heartily drunk.

Mr. ALDERMAN COX proposed "The health of the President," who, he remarked, was entitled to the respect of the members of the Society, as he filled the post of President with considerable zeal and ability. The Alderman went on to point out that the Society taught a man to think, and in that way it did good service, and led to a vast amount of good.

Mr. SAWYER, in reply, regarded his position as an honourable one, and assured the company that he was ready to do anything he could for the promotion of the Society. In conclusion, he mentioned that up to the present time he had never failed to be in his place and punctual at the meetings.

The REV. J. H. CROSS, in proposing "The health of the Vice-Presidents," took that opportunity of putting himself right with regard to an observation which he made at a recent meeting of the Society, reflecting on the theory of Major Hallett, who read a paper on "The Germination of Wheat." He (Mr. Cross) had not heard the paper referred to, and he had no idea that a remark delivered conversationally—that Major Hallett's theory was rubbish—would appear in the next day's paper. He therefore begged to state that he had no opinion at all on the matter, into which he had never gone. He hoped in the future that their little conversations would not be made too much of by their kind friends the reporters.

Mr. HASELWOOD, in acknowledging the compliment, remarked that a step into the field of natural history would benefit man to a great extent, and he appealed to them whether this was not manifested in the readiness with which Mr. Cross had put himself right.

"The health of the Hon. Secretaries (Messrs. T. W. Wonfor and J. Colbatch Clark), the Librarian, and Treasurer" was proposed by Mr. DENNANT, who, referring to the recent illness of Mr. Wonfor, hoped he would be spared for many years to come.

Mr. WONFOR, in returning thanks, humorously referred to the visit which the Society paid to Hurstmonceux twenty years ago, when the party walked from Pevensey to Hurstmonceux and were unable to get any refreshments, and went on to express a hope that the young members would interest themselves in the objects of the Society, and assist him in his pet scheme of the verification of the fauna and flora of the county. He thanked the members for their kind expressions of sympathy during his illness of nine months, and remarked that he had not only received great sympathy from the members, but from the town generally.

Mr. CLARK also responded.

"The Visitors" was proposed by Mr. C. F. DENNET, and acknowledged by the REV. C. PUGH, who observed that there could be no opposition between true religion and true science.

This concluded the *post prandial* proceedings, which were of a social character, and the party, after a stroll round the village, left Hailsham by train, and caught the mail to Brighton at Polegate Junction, reaching the terminus at half-past ten, after spending the twenty-third annual excursion under exceedingly auspicious circumstances.

SEPTE

ORDINARY MEETING—
HIBITION

Mr. T. W. **WONFOR** e
Colorado beetle in its various
periods, chrysalis, and perfect
from America in a pill box
changed either through decom
which they had been killed
Mr. Dowsett. This led to a
of the beetle underneath.

Mr. **DOWSETT** mentioned
had seen had been yellow
Whether the black colour w
all over the under part of the

Mr. **LOMAX** suggested
according to the food upon whi

Mr. **WONFOR** also exhibi
in a letter, and which was
country. He had been unab
belonged, and intended taking
ment of the British Museum.
that part of Africa where it was

Mr. **DOWSETT** thought it wa

Mr. **WONFOR** then called at
tail butterfly, *Papilio Machaon*, w
of two caterpillars found by t
leaves of the cultivated carrot, i
towards the end of July. The ca
Pratt and Sons. One of the cat
transformation, but the other

emerged as a handsome female in August, confirming the opinion that there was an autumn as well as a spring brood.

The question arose how did the caterpillars find their way to the place where found? Had some enthusiast placed them there? Had a female escaped from captivity and laid eggs? This idea was negatived by the fact that *P. Machaon* did not breed in captivity; or had an impregnated female crossed the channel and deposited her eggs in Sussex? This idea was partly confirmed by the fact that on the first of the month a swallow-tail had been taken at Hastings. It was well known that *P. Machaon* was found in considerable numbers in Norfolk and Cambridgeshire, and on the Continent. It is reported that this butterfly was formerly taken in Sussex in the Weald. He quite expected to hear of other specimens being taken in the county next spring.

Mr. DOWSETT exhibited a butterfly new to Britain, *Thais Rumina*, found in the Brighton Market, probably imported in the chrysalis from the Continent with fruit, flowers, or vegetables. At the time of its capture the wings were not quite dry. This species is found in France, from which country it had probably been brought in the way named above.

SEPTEMBER 27TH.

MICROSCOPICAL MEETING.

A number of interesting objects were shown by the President, Mr. G. D. Sawyer, Mr. Wonfor, Mr. Glaisyer, and others, including a series of four slides showing the absorption of sulphate of copper by branch of mistletoe, of acetate of copper by geranium stem, of magenta by stem of mistletoe, and absorption of magenta by stem of clematis.

In the course of conve
some experiments lately carried
with a view to determine whet
of reptilia, found in Mexico,
both ordinary and albino,
Aquarium) was or was not
species (probably the amblysto

Mr. Wonfor remarked t
tried in Brighton by Miss
in a prior discovery by that
at the Brighton Aquarium of
sufficiently high temperature.

The conversation eventual
another form of life, name
respecting which Dr. Corfe
gentleman ultimately promised

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER 1877.

Abbey, H.
Alger, W.
Andress, W.
Ardley, W.
Aylen, S.

Badcock, Dr.
Balean, H.
Baseden, W. H.
Bellingham, C.
Benifold, J. S.
Bigge, A.
Bishop, J. G.
Black, Arthur
Booth, E.
Botting, W.
Boxall, W. P.
Bright, E.
Brown, J. H.
Brown, J. E.
Browne, Hon. Howe
Browne, G.

Capon, J.
Carden, J., Jun.
Carpenter, Charles
Caush, D.
Challen, J.
Champion, F. S.
Clark, J. C.
Clarke, W. T.
Clayton, C. E.
Clowser, T. H.
Cobb, R.
Colling, J. W.
Comlidge, T.
Corfe, Dr.
Cox, A.
Cox, A. H.
Creak, A.
Cross, Rev. J. H.
Curtis, J.
Cutton, T.

Davey, H.
Davis, H. C.
Dawson, Dr.
Deane, W.
Dennant, J.
Dennet, C. F.

Dowsett, A.
Duguid, T. I.
Duke, F.

Eberall, J.
Edmonds, ——

Farr, A. R.
Felton, W.
Fisher, A.
Fowler, T. M.
Fox, O. A.
Friend, Daniel
Friend, D. B.

Glaisyer, J. H.
Glaisyer, R.
Glaisyer, T.
Glaisyer, E.
Goss, H.
Grant, W.
Gwatkin, J. T.

Hack, D.
Haddock, G. J.
Hadlow, F. V.
Hall, Dr.
Hall, E. P.
Hallett, W. H.
Hallifax, Dr.
Hamblin, E.
Hamblin, W. T.
Hamblin, James
Hamilton, C. C.
Hannington, Rev. J.

Lethbridge, E. B.
Leuliette, L.
Loader, A.
Lomax, Benjamin
Lomax, O'Brien
Lucas, A.
Lucas, J. E.
Lulham, E. W.

Mahomed, F.
Marchant, W.
Marshall, E. J.
Massy, Dr. Tuthill
Mayall, J. J. E.
Medcalf, E. S.
Merrifield, F.
Merry, W.
Michael, A. D.
Millard, Dr. W. J. K.
Miles, Dr. E. S.
Mills, A.
Mills, P.
Mitchell, W. W.
Morganti, F.
Morris, J.
Moseley, Rev. T.

Nash, George
Nash, W. H.
Nell, W. T.
Newton, Rev. J.
Nichols, W. H.
Nourse, W. E. C.
Norman, S.

O'Connor, D.

Paine, C.
Pankhurst, E. A.
Patching, E. B.
Patten, A. J.
Penley, M.
Phillips, B.
Phillips, F. B. W.
Pocock, C. J.
Potter, W.
Pratt, H.
Puttick, W.

Ridge, J.
Rogers, R. S.
Roper, F. C. S.
Rose, J.
Ross, Dr. H.
Ross, Douglas
Rowland, C.
Rutter, Dr.
Ryde, M.
Ryde, W.

Sadler, J. H.
Salt, Rev. F. G.
Saltzmann, F. W.
Saunders, Hubert
Saunders, W.
Savage, W. D.
Savage, W. W.
Sawyer, F. E.
Sawyer, G. D.
Saxby, H.

Sayers, J.
Scott, E.
Shaft, G. T.
Simonds. T. R.
Slemen, T.
Smith, C. P.
Smith, Frederick S.
Smith, J. P. M.
Smith, T.
Smith, Walter
Smith, W. W.
Smith, H. S.
Smith, B.
Spooner, C. H.
Stevens, W. G.
Strevens, W. H.
Stride, J. W.

Taaffe, Dr.
Tainsh, E. C.
Thomas, D.
Tuke, J. K.

Verrall, Henry

HONORA

Bloomfield, Rev. E.
Clarkson, Rev. G. A.,
Curteis, J., 244, Hig
Latham, Dr. K. G., L
Lee, H., Croydon.
Mitten, William, Hur
Prince, C. L., Uckfiel
Stevens, Dr., St. Mar
Ward, J., Clifton, Gre

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Honorary Members of the Society :—

Belfast Natural History Society.
Belfast Natural History and Philosphical Society.
Boston (Mass. U.S.A.) Society of Natural Science.
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Club.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Folkestone Natural History Society.
Geological Record.
Geologists' Association.
Glasgow Natural History Society.
Glasgow Society of Field Naturalists'.
Leeds Naturalists' Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid-Kent Natural History Society.
North Staffordshire Naturalists' Field Club.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Society.
Smithsonian Institution, Washington, U.S.A.
Société Belge de Microscopie.
Watford Natural History Society.

TREASURER'S ACCOUNT.

For the year ending October 11th 1877.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Books and Periodicals	13	6	6	By Balance from last year	4	18	4
,, Printing Annual Report	36	8	0	,, Annual Subscriptions due October 1st, 1876 ..	91	0	0
,, ,, Catalogue	8	3	0	,, Arrears due October 1st, 1875	10	0	0
,, ,, Circulars, &c.	14	6	0	,, Entrance Fees	10	0	0
,, Advertising Botany Prize	1	3	6				
,, Stationery, Postages, &c.	8	1	7				
,, Fire Insurance	0	12	0				
,, Bookbinding...	1	9	1				
,, Messenger delivering Notices							

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society

FOR THE

Year Ending 30th September, 1880,

Adopted at a Meeting held on Thursday, Oct. 14, 1880.

Brighton:
G. W. MARKWICK, "GUARDIAN" HYDRAULIC WORKS, 34, NORTH STREET.

1880.

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1880.

HARVARD COLLEGE LIBRARY
INGRAHAM FUND
JUN 10 1942

President:

MR. THOMAS GLAISYER.

Vice-Presidents:

MR. HOLLIS,
MR. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. PENLEY,
MR. W. E. C. NOURSE,
MR. F. MERRIFIELD,
MR. HASELWOOD,
MR. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. ALD. MAYALL,
HON. HOWE BROWNE.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
MR. ALD. HALLETT,
DR. CORFE,
DR. MILES,
THE REV. H. G. DAY.

Honorary Secretaries:

MR. BENJAMIN LOMAX,
11, PARK CRESCENT TERRACE.

MR. J. COLBATCH CLARK,
56, MIDDLE STREET.

Honorary Librarian and Curator:

MR. R. GLAISYER,
THE DISPENSARY.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, October 14th, 1880,

IT WAS RESOLVED,—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President and Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. Alderman Hallett, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, and the Rev. H. G. Day; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark; Honorary Librarian and Curator: Mr. Robert Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

(Signed) J. E. MAYALL,
Chairman.

IT WAS ALSO RESOLVED,—

That the thanks of this Meeting be presented to the Hon. Howe Brown for his able conduct as President during the past year.

REPORT.

In presenting their Report for the year ending the 30th of September, 1880, your Committee, whilst having the pleasure of recording the continued financial prosperity of this Society, very much regret that the attendance at the Meetings during the past year has not been so large as in previous years, and particularly that the Microscopical Meetings have for some time been so thinly attended, that your Committee have thought it desirable to discontinue them altogether for the present, and they would urge upon the Members to use their best exertions to further the objects of the Society by attending its Meetings, and by reading Papers and promoting discussion on the Papers read by others, and by bringing before the Society all matters of interest relating to Natural History with which they may become acquainted.

Your Committee much regret the loss of Mr. Gwatkin, who died in March last; he was one of the Vice-Presidents of the Society, and had been one of its most useful Members, having for many years taken the entire charge of the Library, and provided accommodation for it at his residence.

All the Liabilities of the Society have been discharged, and there is now a balance in the hands of the Treasurer amounting to £101 16s. 7d. A Statement of the Accounts for the year is annexed.

The number of Members
the year. A list of the presen
report.

A List of the Books which h
during the year, and also a List o
year, are appended to this report.

The Conversazione was held
of March, and was very succes
Members and friends.

The Field Excursions during
1879: October 11th, to Hasso
Burgess Hill; June 12th, to F
September 11th, to Crowborough

The Excursion to Crowboro
of Mr C. L. Prince, by whom
entertained.

The Annual Excursion took p
The party also visited Wiston
entertained by the Rev. John Gori
pleasant day was spent, though
previous years, except 1879.

A List of the Papers read
appended to this Report, and th
to those gentlemen who have read

The Committee have again
Government of the United States

for their great and continued liberality in forwarding valuable Reports and other Papers.

The following is a List of the Papers read at the Ordinary Meetings :—

1879 : October, on "The Elephant Bed near Brighton," Mr. R. H. Stevens; November, "The Edentata," Mr. B. Lomax; December, "Nature's Cycles," Rev. H. G. Day.—1880 : February, "The Protococcus and its Allies," Mr. H. Edmonds; April, "Traces of the Earlier Inhabitants of North Hampshire," contributed by Dr. J. V. Stevens; May, "The Leaf: Its Structure and Functions," Mr. Caush; June, "The Last Field Excursion," Rev. J. H. Cross; September, "An Early British City," Dr. Miles.

The following Books have been presented to the Society during the year :—

The Insect Fauna of the Secondary or Mesozoic Period, by H. Goss, F.L.S. (from the Author); Three vols. Ornithological Miscellanies, by G. D. Rowley, F.L.S. (from Mrs. Rowley); How to Work with the Microscope, by Lionel Beale (from the Author); The Rot in Sheep, by J. B. Simonds (from C. F. Dennet); Guida de l'Acquaria di Napoli (from H. J. Matthews); Six copies of Leisure Hour, containing the Underground Geology of the South East of England, by Miss Agnes Crane (from the Authoress); Geological Antiquity of Insects, by H. Goss, F.L.S. (from the Author); Notes on the Palæozoic Crustacea (Merostomata), by H. Woodward, F.G.S. (from H. Willett); Palæontology of the Coasts of the Arctic Lands, Position of the Silurian, Devonian, and Carboniferous Rocks of the London Area, by R. Etheridge, F.RS.

(from the Author); Photographs
Lewes, and of the Hermitage Roc
Report of the Smithsonian Institu
of the United States Survey of t
Cretaceous and Tertiary Plants;
Comptroller of the Currency for
the Publications of the U.S. Geol
of the Territories (from the Gove
Annual Report of the Belfast N
1878, and 1879; Report of North
Club for 1879; Transactions and Pr
Field Club for 1876-77-78-79; Th
Geologists' Association; Journal of
Reports of Royal Microscopical Soc
Naturalists' Society for 1879; Trans
Society;—from the Secretaries of th

The following Books have been
Free and Semiparasitic Copeboda
Stewardson Brady, F.L.S. (Ray Sc
(Part 2, Filices), by J. S. Gardner, F.
Ph.D.; British Oolitic Echinodermata
by T. Wright, F.R.S.; British Fossil
F.R.S. (Supplement to the Permian
Ammonites of the Lias of the British
Reptilia of the London Clay, by Pro
tological Society); La Maout and D

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER, 1880.

Aylen, S.
Abbey, H.
Andrews, A. R.

Bellingham, C.
Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall. W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe.
Benifold, J. S.
Bishop, J. G.
Botting, W.
Baseden, W. H.
Brinton, R.
Blaker, T. F. I.
Beverley, Rev. H. W.
Benson, G. F.

Clark, J. Colbatch
Curtis, J.
Cross, Rev. J. H.
Cox, A. H.
Creak, A.
Carpenter, C.
Capon, J.
Clayton, C. E.
Corfe, Dr.
Clowser, T. H.
Challen, W.
Cobb, R.
Clarke, W. T.
Champion, F. S.
Comlidge, T.
Caush, D. E.
Cowley, F., Jun.
Charington, H.
Chapman, E.

Dennant, J.
Dowsett, A.
Davey, H.
Dennet, C. F.
Deane, W.
Duguid, T. I.

Davis, H. C.
Day, Rev. H. G.
Drewett, S.
Duke, F.

Edmonds, H.

Fox, O. A.
Fowler, T. M.
Friend, D. B.
Friend, Daniel
Fisher, A.
Felton, W.
Farr, A. R.
Fisher, S. W.

Glaisyer, T.
Glaisyer, R.
Glaisyer, J. H.
Graham, J. T.
Goss, H.
Grant, W.

Hauxwell, Dr. H. F.
Hallifax, Dr.
Hollis, W. M.
Hadlow, F. V.
Henty, W.
Haselwood, J. E.
Harris, E. H.
Hallett, W. H.
Hart, E. J.
Hilton, W.
Hurst, H.
Hamilton, C. C.
Hobbs, J.
Heald, C. J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hannington, Rev. J.
Hoadley, A.
Hall, E. P.
Holloway, A.
Hamblin, J.
Haynes, J. L.
Hodgson, G. F.

Infield, H. J.

Jackson, A. W.
Jackson, W.
Jenner, J. H. A.

Knightley, Dr.
King, Dr. J. B.

Leuliette, L.
Lee, W. R.
Lomax, B.
Lethbridge, E. B.
Lucas, J. E.
Leigh, T.
Lucas, A.
Lee, J. S.
Lomax, O'Brien
Lulham, E. W.
Loader, A.
Langton, H.
Lockyer, G. R.

Likeman, J.

Merrifield, F.
Moseley, Rev. T.
Marshall, E. J.
Mayall, J. J. E.
Mills, P.
Mitchell, W. W.
Millard, Dr. W. J. K.
Morris, J.
Medcalf, E. S.
Mills, A.
Marchant, W.
Merry, W.
Miles, Dr. E. J.

Nash, G.
Nash, W. H.
Nye, H.
Nourse, W. E. C.
Norman, S.

Penley, M.
Phillips, B.
Pocock, C. J.
Pratt, H.
Pankhurst, E. A.
Puttick, W.
Paine, C.
Patten, A. J.

Ross, Dr. Harris.
Rutter, Dr.
Ross, Dr. Douglas.
Rose, J.
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, H. S.
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E.
Simonds, T. R.
Salzmann, F. W.
Stride, J. W.
Strevens, W. H.
Slemen, T.
Spooner, C. H.
Sayers, J.
Stevens, R. H.
Saxby, H.

Tuke, J. K.
Thomas, D.
Trasenster, E. A.
Tasker, J.

Verrall, Henry.
Verrall, Hugh J.

Wallis, M.
Wallis, W. C.

TREASURER'S ACCOUNT.

FOR THE YEAR ENDING SEPTEMBER 30, 1880.

Dr.

	£	s.	d.
To Books and Periodicals	8	5	2
,, Printing Circulars, &c.	11	8	3
,, Stationery and Postages	1	6	8
,, Fire Insurance	0	12	0
,, Bookbinding...	0	18	4
,, Messenger delivering Notices	4	2	0
,, Commission to Collector for Subscriptions	3	4	6
,, Assistant Secretary	1	10	0
,, Donation to Assistants at Museum ...	2	10	0
,, Carriage of Books	0	2	4
,, Lamp, Spirit, and Glasses	0	4	6
,, Expenses of Soirée	11	18	0
,, Expenses of Annual Excursion	2	16	9
	48	18	6
,, Balance in hands of Treasurer	101	16	7
	£150	15	1

Cr.

	£	s.	d.
By Balance from last year	49	5	1
,, Annual Subscriptions, October 1st, 1879...	80	0	0
,, Arrears due October 1st, 1878	18	0	0
,, Entrance Fees	3	10	0
	£150	15	1

Examined and found correct.

JAS. WM. STRIDE, } *Auditors.*
ROBERT GLAISYER, }

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society

FOR THE

Year Ending 30th September, 1881.

Adopted at a Meeting held on Thursday, Oct. 20, 1881.

Brighton:
PRINTED AT THE "GUARDIAN" HYDRAULIC WORKS, 34, NORTH STREET.

1881.

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society

FOR THE

Year Ending 30th September, 1881.

Adopted at a Meeting held on Thursday, Oct. 20, 1881.

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1881.

HARVARD COLLEGE LIBRARY
INGRAHAM FUND
JUN 10 1942

President:

REV. H. G. DAY.

Vice-Presidents:

MR. HOLLIS,
MR. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. PENLEY,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
MR. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. J. J. E. MAYALL,
HON. HOWE BROWNE.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
MR. ALD. HALLETT,
DR: CORFE,
DR. MILES,
MR. F. E. SAWYER.

Honorary Secretaries:

MR. BENJAMIN LOMAX,
11, PARK CRESCENT TERRACE.

MR. J. COLBATCH CLARK,
64, MIDDLE STREET.

Honorary Librarian and Curator:

MR. R. GLAISYER,
THE DISPENSARY.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, October 20th, 1881,

IT WAS RESOLVED,—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Rev. H. G. Day; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. Alderman Hallett, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, and Mr. F. E. Sawyer; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark; Honorary Librarian and Curator: Mr. Robert Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

(Signed) THOS. GLAISYER,
Chairman.

IT WAS ALSO RESOLVED,—

That the thanks of this Meeting be presented to Mr. T. Glaisyer for his able conduct as President during the past year.

REPORT.

In presenting their Report for the year ending the 30th of September, 1881, your Committee are pleased to be able to record the continued financial prosperity of this Society, and an improvement in the attendance at the Meetings during the past year, but feel it necessary again to ask the Members to use their best exertions to further the objects of the Society by attending its Meetings, and by reading Papers and promoting discussion on the Papers read by others, and by bringing before the Society all matters of interest relating to Natural History with which they may become acquainted.

All the liabilities of the Society have been discharged, and there is now a balance in the hands of the Treasurer amounting to £114 3s. 2d. A statement of the Accounts for the year is annexed.

The number of Members has decreased slightly during the year. A list of the present Members is appended to this Report.

A list of the Books which have been presented to the Society during the year, and also a list of the Books purchased during the year, is appended to this Report. The Conversazione was held at the Royal Pavilion, on the 24th of March, and was very successful, having been attended by 532 Members and friends.

The Field Excursions du
follows:—1880: October 16th, to S
Falmer; June 11th, to Arundel; Ju
13th, to West Grinstead; Septembe

The Excursion to Newhaven
Cox having kindly invited the Mem
yacht.

The Annual Excursion took
Bolney and Wykehurst, and a very pl

A list of the Papers read
appended to this Report, and the
to those gentlemen who have read

The Committee have again
Government of the United States and
their great and continued liberality in
and other papers.

The following is a List of the
Meetings:—

1880: October, on "The Legend of the
"and its Origin," by Mr. Freder

November, "On some of the Characte
"South America, as delineated b
"interspersed with remarks on
"and achievements," by Mr. G.

1881: January, on "Plants and their
by Miss Barnard.

1881: February, on "The Natural History of Rake," by Mr. B. Lomax.

April, on "An Hour in a Coal Mine," by Mr. R. H. Stevens.

May, on "The Theory of Evolution," by the Rev. H. G. Day.

September, on "A Species of Lepeoptheirus probably undescribed," written by the Rev. E. T. Stubbs, and read by his son, Mr. John Hamilton Stubbs.

Donations of the following Books have been received:—

Hampshire Inn Signs, by Dr. J. Stevens (from the Author); Evolution, a Paper read May 12, 1881, and Geological Teaching, by Rev. H. G. Day (from the Author); Geological Antiquity of Insects, by H. Goss, F.L.S. (from the Author); Arctic Exploration in search of Sir John Franklin (from R. Glaisyer); Commercial Products of the Animal Kingdom, by P. L. Simmons (from the Author); Geological Map of England and Wales (from H. Willett), 6 numbers; Examples of Works of Art in South Kensington Museum (from H. Willett); Report of Smithsonian Institute for 1879 (from the Government of the United States of America); Parts 57-58 Cassell's Natural History; Bryozoa and Brachiopoda, by Miss Crane (from the Authoress). Also, from the respective Secretaries of the following Societies:—Transactions and Proceedings of Croydon Microscopical and Natural History Club; Transactions of Barrow Naturalists' Field Club, Vols. 1, 2, 3, 1876 to 1879; Reports and Proceedings of Belfast Naturalists' Field Club, 1876-1879; Annual Report of North Staffordshire Naturalists' Field Club, 1878-1880; Report and Transactions of Cardiff Naturalists' Society, Vols. 10, 11, 12, 1878-1880; Transactions of

Edinburgh Geological Society, Vol. 3, Part 2; Transactions of Epping Forest and County of Essex Naturalists' Field Club, Vol. 1; Inaugural Address of President, and Vol. 2, Part 1; Tenth Annual Report of the Chester Society of Natural Science; Proceedings of Belfast Natural History and Philosophical Society, 1878-1880; Inaugural Address by B. Halgate, F.R S., to Leeds Geological Association; Proceedings of Société Belge de Microscopie; Transactions of Edinburgh Geological Society, season 1880-1881.

The following Books have been purchased during the year:—Wallace's Island Life, Huxley's Cray-fish, Dawkins' Early Man in Britain, Geikie's Prehistoric Europe, Tyler's Anthropology, Braithwaite's Flora, Gunther's Fishes, Challenger Expedition, 2 Vols. (Zoology), Nicholson's Palæontology, Hull's Geology of Ireland, Darwin's Movement of Plants; The Cretaceous Echinodermata, by T. Wright, F.R.S. (Vol. 1, Part 9);—Supplement to Fossil Brachiopoda (Devonian and Silurian), by T. Davidson, F.R.S. (Vol. 4, Part 4); Supplement to Fossil Trigoniæ, by Dr. Lycett; Ammonites of the Lias, by T. Wright, F.R.S. (Part 4); The Reptilia of the Liassic Formations, by Professor Owen (Part 3); The Fossil Elephants (Elephas Primigenius and Meridionalis), by Professor Leith Adams (Part 3), Palæontological Society.

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER, 1881.

Aylen, S.
Abbey, H.
Andrews, A. R.

Bellingham, C.
Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Brown, Hon. Howe.
Bishop, J. G.
Botting, W.
Brinton, R.
Blaker, T. F. I.
Beverley, Rev. H. W.
Benson, G. F.

Clark, J. Colbatch
Curtis, J.
Cross, Rev. J. H.
Cox, A. H.
Carpenter, C.
Capon, J.
Corfe, Dr.
Clowser, T. H.
Challen, W.
Cobb, R.
Clarke, W. T.
Champion, F. S.
Comlidge, T.
Caush, D. E.
Cowley, F., Jun.
Charington, H.
Chapman, E.

Dennant, J.
Davey, H.
Dennet, C. F.
Deane, W.
Davis, H. C.
Day, Rev. H. G.
Duke, F.

Edmonds, H.
Evans, George.

Fox, O. A.
Fowler, T. M.
Friend, D. B.
Friend, Daniel.
Farr, A. R.
Fisher, S. W.
Fayle, J.

Glaisyer, T.
Glaisyer, R.
Glaisyer, J. H.

Haxwell, Dr. H. F.
Hallifax, Dr.
Hollis, W. M.
Hadlow, F. V.
Haselwood, J. E.
Harris, E. H.
Hallett, W. H.
Hart, E. J.
Hurst, H.
Hobbs, J.
Heald, C. J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hannington, Rev. J.
Hoadley, A.
Holloway, A.
Hamblin, J.
Haynes, J. L.
Hodgson, G. F.

Infield, H. J.

Jackson, A. W.
Jackson, W.
Jenner, J. H. A.
James, R. A.

Knightley, Dr.

Leuliette, L.
Lee, W. R.
Lomax, B.
Lethbridge, E. B.
Lucas, J. E.
Leigh, T.
Lucas, A.
Lee, J. S.
Lomax, O'Bryen.
Lulham, E. W.
Loader, A.
Langton, H.
Lockyer, G. R.
Likeman, J.

Merrifield, F.
Moseley, Rev. T.
Marshall, E. J.
Mayall, J. J. E.
Mills, P.
Mitchell, W. W.
Millard, Dr. W. J. K.
Morris, J.
Medcalf, E. S.
Mills, A.
Marchant, W.
Merry, W.
Miles, Dr. E. J.

Nash, G.
Nash, W. H.
Nye, H.
Nourse, W. E. C.
Norman, S.
Newnham, J. M.

Penley, M.
Phillips, B.
Pocock, C. J.
Pratt, H.
Pankhurst, E. A.
Puttick, W.
Paine, C.
Poundall, W. L.
Parton, F.

Ross, Dr. Harris.
Rutter. Dr.
Ross, Dr. Douglas.
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodham.
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E.
Simonds, T. R.
Salzmann, F. W.
Stride, J. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Stevens, R. H.
Saxby, H.
Street, Arthur.
Sanderson, Rev. E.

Thomas, D.
Trasenster, E. A.
Tasker, J.
Trenchard, J. A

Verrall, Henry.
Verrall, Hugh J.

Wallis, M.
Wallis, W. C.
Wallis, E. A.
Wills, J.
Wood, W. R.
Wood, W. R., Jun.
Wood, J.
Williams, H. M.
Woodman, James.
Welch, J. E.
Wilkinson, T.
Willett, H.
Warden, E.

HONORARY MEMBERS.

Bloomfield, Rev E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
Prince, C. L.
Stevens, Dr.
Ward, J. Clifton.

LADY SUBSCRIBERS.

Barnard, Miss.
Woollams, Mrs. Henry.

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.)
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Society.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalists' Field Club.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society.
Glasgow Society of Field Naturalists.
Leeds Naturalists' Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid Kent Natural History Society.
North Staffordshire Naturalists' Field Club.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institution, Washington, U.S.A.
Société Belge de Microscopie, Bruxelles.
Watford Natural History Society.

TREASURER'S ACCOUNT.

FOR THE YEAR ENDING SEPTEMBER 30, 1881.

Dr.	£	s.	d.
To Books and Periodicals	20	12	3
,, Printing—Circulars, Reports, &c.	18	7	3
,, Stationery and Postages	4	11	0
,, Fire Insurance	0	12	0
,, Bookbinding	1	4	6
,, Messenger delivering Notices	3	18	6
,, Commission to Collector for Subscriptions	2	15	0
,, Assistant Secretary	1	10	0
,, Donation to Assistants at Museum	2	10	0
,, Carriage of Books	0	4	3
,, Expenses of Soirée	15	14	11
,, Expenses of Annual Excursion	0	18	3
,, New Book Cases	7	7	6
	80	5	5
,, Balance in hands of Treasurer	114	3	2
	£194	8	7

Cr.	£	s.	d.
By Balance last Year	101	16	7
,, Annual Subscriptions	75	0	0
,, Arrears due October 1st, 1880	15	0	0
,, Entrance Fees	2	10	0
,, Overpayment in Subscriptions	0	2	0
	£194	8	7

Examined and found correct, October 8th, 1881.

JAS. WM. STRIDE, } AUDITORS.
ROBERT GLAISYER, }

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society,

FOR THE

YEAR ENDING 30TH SEPTEMBER, 1882.

Adopted at a Meeting held on Thursday, October 12th, 1882.

Brighton:
PRINTED AT THE "GUARDIAN" HYDRAULIC WORKS, 34, NORTH STREET.

1882.

ANNUAL REPORT

OF THE

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Natural History Society,

FOR THE

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1882.

HARVARD COLLEGE LIBRARY
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JUN 10 1942

President:

DR. W. A. HOLLIS.

Vice-Presidents:

MR. HOLLIS,
MR. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
MR. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. J. J. E. MAYALL,
HON. HOWE BROWNE,
REV. H. G. DAY.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
DR. CORFE,
DR. MILES,
MR. F. E. SAWYER,
MR. E. J. PETITFOURT.

Honorary Secretaries:

MR. BENJAMIN LOMAX,
11, PARK CRESCENT TERRACE.

MR. J. COLBATCH CLARK,
64, MIDDLE STREET.

Honorary Librarian and Curator:

MR. R. GLAISYER,
THE DISPENSARY.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, October 12th, 1882,

IT WAS RESOLVED,—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the Minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Dr. W. A. Hollis; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, Mr. F. E. Sawyer, and Mr. E. J. Petitfourt; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark; Honorary Librarian and Curator: Mr. Robert Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

That the thanks of this Meeting be presented to the Rev. H. G. Day for his able conduct as President during the past year.

(Signed) THOS. GLAISYER,
Chairman.

REPORT.

Your Committee are pleased to be able to report the continued prosperity of the Society during the year which terminated on the 30th of September, 1882, and an improvement in the attendance at the meetings.

The Committee have arranged to recommence the holding of Monthly Microscopical Meetings on the fourth Thursday in every month, commencing on the 26th of October, and they have also arranged to receive the paper edited by Mr Arthur C. Cole, F.R.M.S., and published under the name of "Studies in Microscopical Science," with the mounted objects issued with it; and Mr. E. J. Petitfourt has kindly undertaken the care of the papers and objects with the introduction of them at the meetings. It is hoped that this arrangement will materially facilitate the object of the Microscopical Meetings, and make them additionally interesting.

The Financial condition of the Society is very satisfactory, there being now a balance in the hands of the Treasurer amounting to £129 11s. 8d. A statement of the Accounts for the year is annexed.

The number of Members remains about the same as last year. A list of the present Members is appended to this report.

The Committee much regret the loss which the Society sustained by the death of Mr. Montague Penley, one of the Vice-Presidents, and one of the earliest supporters of the Society.

A list of the Books which have been presented to the Society during the year, and also a list of the Books purchased during the year, is appended to this report.

The Conversazione was held at the Royal Pavilion on the 22nd of March, and was very successful, having been attended by 380 Members and friends.

The Field Excursions during the year have been as follows :—1881 : October 15th, to Glynde ; 1882 : May 13th, to Haywards Heath ; June 10th, to Glynde ; July 15th, to Ford ; September 16th, to Barcombe.

Instead of a Field Excursion in August, the kind invitation of Mr. Alderman Cox to make an excursion to sea on board his steam yacht was accepted, and a large number of the Members spent a most enjoyable afternoon. The thanks of the Society are due to Mr. Alderman Cox for his kind and generous hospitality on this and previous occasions.

The Annual Excursion took place on the 6th of July, to Horsham, and by the kind permission of Mr. Hubbard the party visited the Mansion and Grounds at Leonardslee, when, notwithstanding very inclement weather, a pleasant day was spent.

A list of the papers read at the Ordinary Meetings is appended to this report, and the thanks of the Society are due to those gentlemen who have read them.

The Committee have again to record their thanks to the Government of the United States and the Smithsonian Institute for their great and continued liberality in forwarding valuable reports and other papers.

The following is a list of the papers read at the Ordinary Meetings :—

1881 : November : On "An enquiry into the nature and origin of "certain foraminiferous fossils in sand, with specimens "illustrating the subject," by Mr Eustace A. Brickwell, M.R.C.S.

December : On "Water in its relation to the constitution of the "World," by the Rev. H. G. Day.

1882 : January : "On some of the changes which have taken "place in the relative level of land and sea during the last "Twenty Centuries," by Mr. E. A. Pankhurst.

February : "On the functions and modifications of Leaves," by Mr. B. Lomax.

March : "On the Vertebrate Animal considered as a Machine," by the Rev. H. G. Day.

April : An evening devoted to the Exhibition of Specimens.

May : "On polarization of Light and Heat," by Mr. E. J. Petitfourt, B.A.

June : On "Sussex Fish and Fisheries," by Mr. Frederick E. Sawyer, F.M.S.

July and August : Vacation.

September : On "Gums and Resins," by Mr. W. F. Nation.

Presentations of the following Books have been received during the year:—

Elementary Botany, by Henry Edmonds (from the Author); On some Artificial Forms of Silica, by J. I'Anson, F.G.S., and E. A. Pankhurst (from E. A. Pankhurst); Evolution, by Rev. H. G. Day, Geological Teachings, by the same (from the Author); Sussex Fish and Fisheries, by F. E. Sawyer (from the Author); The Scientific Roll, by A. Ramsay; Easy Method of Studying British Wild Flowers, by F. A. Messer; Report of the Smithsonian Institution (from the Department of the Interior, Washington, U.S.A.); Transactions of Epping Forest and County of Essex Naturalists' Field Club; Proceedings of the Societé Belge de Microscopie; Proceedings of Norwich Geological Society; Address to Ditto, by J. H. Blake; Catalogue of Mayer Collection of Babylonian and Assyrian Antiquities; Catalogue of the Loan Collection at the Walker Gallery, Liverpool; Report of Chester Society of Natural Science; Transactions of Eastbourne Natural History Society; Transactions of Belfast Naturalists' Field Club, Vol. 1, Part 7, Vol. 2, Part 1; Proceedings of Cardiff Naturalists' Field Club; Transactions of North Staffordshire Naturalists' Field Club and Archæological Society; Proceedings of the Belfast Natural History and Philosophical Society (from the respective Secretaries).

The following Books have been purchased during the year:—Bushby on Mosses, Saville Kent's Infusoria (5 Parts), Topley's Geological Survey, Keller's Lake Dwellings (2 Vols.), Lyell's Life (2 Vols.), Huxley's Critiques and Addresses, Huxley's Science and Culture, Forbes' Star Fishes, Lubbock's Origin of

Civilization, Seebohm's Siberia in Europe, Ramsay's Physical Geography, Anatomy of Vertebrated Animals, Anatomy of Invertebrated Animals, Darwin's Fertilization, Darwin's Vegetable Moulds and Earth Worms, S. Thompson's Electricity, Huxley's Sermons, Roscoe's Chemistry, Unwin's Genera of British Mosses, Challenger Expedition (Vols. 3 and 4, Edward Hull, M.A., F.R.S.), Coal Fields of Great Britain (James Giekie, LL.D.), The Great Ice Age (2nd Edition), Fouque's Mineralogie Micrographique (2 Vols.).

LIST OF M

OF THE

Brighton & Sussex Natu

OCTOBER,

Aylen, S.
Abbey, H.
Andrews, A. R.

Bellingham, C.
Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe
Bishop, J. G.
Botting, W.
Brinton, R.
Blaker, T. F. I.
Beverley, Rev. H. W.
Benson, G. F.
Barnes, J.
Baker, J. S.
Buchel, C.
Burrell, W. H.

Eisenhofer, A. A.

Fox, O. A.
Fowler, T. M.
Friend, D. B.
Friend, Daniel
Farr, A. R.
Fisher, S. W.
Fayle, J.
Freeman, C. G.

Glaisyer, T.
Glaisyer, R.
Glaisyer, J. H.

Hallifax, Dr.
Hollis, W. M.
Hadlow, F. V.
Haselwood, J. E.
Harris, E. H.
Hallett, W. H.
Hart, E. J.
Hurst, H.
Hobbs, J.
Heald, C. J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hannington, Rev. J.
Hoadly, A.
Holloway, A.
Hamblin, J.
Haynes, J. L.

Infield, H. J.

Jackson, A. W.
Jackson, W.
Jenner, J. H. A.
James, R. A.

Leuliette, L.
Lee, W. R.
Lomax, B.
Lucas, J. E.
Leigh, T.
Lucas, A.
Lee, J. S.
Lulham, E. W.
Loader, A.
Langton, H.
Lockyer, G. R.

Merrifield, F.
Marshall, E. J.
Mayall, J. J. E.
Mills, P.
Mitchell, W. W.
Millard, Dr. W. J. K.
Morris, J.
Medcalf, E. S.
Mills, A.
Marchant, W.
Merry, W.
Miles, Dr. E. J.
Moon, Dr. W.

Nash, G.
Nash, W. H.

Nye, H.
Nourse, W. E. C.
Norman, S.
Newnham, J. M.

Phillips, B.
Pocock, C. J.
Pratt, H.
Pankhurst, E. A.
Puttick, W.
Paine, C.
Poundall, W. L.
Parton, F.
Peek, R.
Petitfourt, E. J.

Ross, Dr. Harris
Rutter, Dr.
Ross, Dr. Douglas
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodham
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E. E.
Simonds, T. R.
Salzmann, F. W.
Stride, J. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Stevens, R. H.
Saxby, H.
Street, Arthur
Smith, Dr. Tyler

Thomas, D.
Tasker, J.
Trenchard, J. A.

Verrall, Henry
Verrall, Hugh J.

Winter, J. N.
Wallis, M.
Wallis, W. C.
Wallis, E. A.
Wills, J.
Wood, W. R.
Wood, W. R., Jun.
Wood, J.
Williams, H. M.
Woodman, James
Wilkinson, T.
Willett, H.
Warden, E.
Wellbye, H.
Walker, T.

HONORARY MEMBERS.

Bloomfield, Rev. E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
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Stevens, Dr.
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Barnard, Miss
Langridge, Miss
Woollams, Mrs. Henry

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
? Boston Society of Natural Science (Mass., U.S.A.)
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Society.
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalists' Field Club.
Folkestone Natural History Society.
Geologists' Association.
Glasgow Natural History Society.
Glasgow Society of Field Naturalists.
Leeds Naturalists' Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid Kent Natural History Society.
North Staffordshire Naturalists' Field Club.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institution, Washington, U.S.A.
Société Belge de Microscopie, Bruxelles.
Watford Natural History Society.

TREASURER'S ACCOUNT.

For the Year ending 1st October, 1882.

Dr.	£	s.	d.
To Books and Periodicals	26	13	10
,, Printing, Circulars, &c.	8	12	6
,, Stationery, Postages, &c.	2	11	0
,, Fire Insurance	0	12	0
,, Subscription to Studies in Microscopical Science	4	9	0
,, Messenger delivering Notices	4	6	0
,, Commission to Collector for Subscriptions	2	7	9
,, Assistant Secretary	1	10	0
,, Donations to Assistants at Museum	2	15	0
,, Carriage of Books and Lamp Spirit	0	5	11
,, Expenses of Soirée	15	1	0
,, Expenses of Annual Excursion	1	18	0
,, Balance in hands of Treasurer	129	11	8
	£200	13	8

Cr.	£	s.	d.
By Balance in hands of Treasurer, 1st Oct., 1881	114	3	2
,, Annual Subscriptions	71	0	0
,, Arrears due 1st October, 1881, since received	10	0	0
,, Entrance Fees	5	10	0
,, Overpayment of a Subscription	0	0	6
	£200	13	8
,, Balance brought over	129	11	8

Examined and found correct, October 11th, 1882.

JAS. WM. STRIDE, } AUDITORS.
ROBERT GLAISYER, }

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society,

FOR THE

YEAR ENDING 30TH SEPTEMBER, 1883.

Adopted at a Meeting held on Thursday, October 11th, 1883.

Brighton:
PRINTED AT THE "GUARDIAN" HYDRAULIC WORKS, 34, NORTH STREET
1883.

ANNUAL REPORT

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Natural History Society,

FOR THE

YEAR ENDING 30TH SEPTEMBER, 1883.

Adopted at a Meeting held on Thursday, October 11th, 1883.

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1883.

HARVARD COLLEGE LIBRARY
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JUN 10 1942

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DR. W. A. HOLLIS.

Vice-Presidents:

MR. HOLLIS,
MR. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
MR. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. J. J. E. MAYALL,
HON. HOWE BROWNE,
REV. H. G. DAY.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
DR. CORFE,
DR. MILES,
MR. F. E. SAWYER,
MR. E. J. PETITFOURT.

Honorary Secretaries:

MR. BENJAMIN LOMAX,
11, PARK CRESCENT TERRACE.

MR. J. COLBATCH CLARK,
64, MIDDLE STREET.

Honorary Librarian and Curator:

MR. R. GLAISYER,
THE DISPENSARY.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, October 11th, 1883,

IT WAS RESOLVED,—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the Minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Dr. W. A. Hollis; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, Mr. F. E. Sawyer, and Mr. E. J. Petitfourt; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark; Honorary Librarian and Curator: Mr Robert Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

That the thanks of this Meeting be presented to Dr. W. A. Hollis for his able conduct as President during the past year.

(Signed) W. A. HOLLIS,
Chairman.

ANNUAL REPORT

OF THE

Brighton & Sussex Natural History Society.

Your Committee are pleased to be able to report the continued prosperity of the Society during the year which terminated on the 30th September, 1883.

The Microscopical Meetings have been held during the year according to the arrangement mentioned in the last report, and your Committee are pleased to be able to state that they have been very successful. It has been arranged to continue the receipt of the paper edited by Mr. Arthur C. Cole, F.R.M.S., and published under the name of "Studies in Microscopical Science," with the mounted objects issued with it, which have been found very useful in promoting the interest of the Meetings. A Microscope for the use of the Members has been purchased.

The Financial condition of the Society is very satisfactory, there being now a balance in the hands of the Treasurer amounting to £110 13s. A Statement of the Accounts for the year is annexed.

The number of Members has slightly decreased during the year. A list of the present Members is appended to this Report. Members are requested to endeavour to increase the prosperity of the Society by bringing its advantages under the notice of their friends.

A list of the Books whi
Society during the year, and
during the year, is appended to

A Supplementary Catalog
Library since the printing of t
published and may be obtained

The Conversazione was h
14th of March, and was very suc
465 Members and friends.

The Field Excursions during t

1882.—October 1
1883.—May 12th,
„ June 16th,
„ July 14th,
„ September

The Annual Excursion to
the Fisheries Exhibition at South
were kindly received by Henry L
Honorary Members of the Societ
mittee of the Fisheries Exhibition
objects of particular interest in th

A list of the papers rea
appended to this report, and the
to those gentlemen who have rea

The thanks of the Society
careful preparation of the Supplem
E. J. Petitfourt for the able way in
subjects at the Microscopical Mee

The Committee have agai
Government of the United States
for their great and continued lib
reports and other papers.

The following is a list of the papers read at the Ordinary Meetings:—

1882.—October: An evening devoted to the Exhibition of Specimens.

„ November: On "Fats and Oils, Glucose and Starch," by Dr. Corfe.

„ December: On "Spiders' Webs," by Mr. W. H. Strevens.

1883.—January: On "Motes from a Sunbeam under the Microscope, or Air-Dust, its Nature and Significance," by Dr. W. A. Hollis.

„ February: On "The Glacial Period in Geology, and certain Modern Theories of the causes thereof,' by the Rev. H. G. Day.

„ March: "A few Notes on Meteorites," by Dr. Miles.

„ April: On "Gills and Lungs, their development and differentiation," by Mr. E. J. Petitfourt.

„ May: An evening devoted to the Exhibition of Specimens.

„ June: On "Sussex Natural History Folk-Lore and Superstitions," by Mr. F. E. Sawyer.

„ July and August: Vacation.

„ September: An evening devoted to the Exhibition of Specimens.

The following is a list of the subjects introduced at the Microscopical Meetings:—

1882.—October: Pinna of Cow's Ear; Stem of Copper Beech; Shaft of Human Clavicle; Stem of Umbrella Plant; by Mr. E. J. Petitfourt.

1882.—November: Rock Pikrite; Human Skin; Human Liver; Human Kidney; by Messrs. E. A. Pankhurst and E. J. Petitfourt.

„ December: Spinal Cord of Cat; Cat's Liver; by Mr. E. J. Petitfourt.

1883.—January: Rachis of Bracken Fern; Thallus of Fucus Vesiculosus; by Mr. B. Lomax.

„ March: Bronchus of Sheep, by Mr. E. J. Petitfourt.

„ April: Dolerite from Dalmahay Hill, by Mr. E. J. Petitfourt.

„ May: Some Sections of Granitic Rocks, by Mr. E. A. Pankhurst.

„ June: Section of Colt's Foot, by Mr. E. J. Petitfourt.

„ July and August: Vacation.

Presentations of the following books have been received during the year:—

Alphabetical Catalogue of Specimens of Fossil Fishes in the collection of Sir de M. Guy Egerton, Bart.; Results of Experiments on the Potato Crop, by G. Maw; Address by the President of the Liverpool Geological Society; Proceedings of the Warwickshire Naturalist and Archæological Field Club, 1880; British Art, 50 years' retrospect, 1832 to 1883, by G. Wallace; Plea for the Rainband, by J. R. Capron; Quarterly Journal of Geological Society, Nos. 150, 154, 155; Memoire sur les Fossiles des Environs de Paris, 1 vol., 1873, by M. Lamarck; Monograph of the Fossil Reptilia of the London Clay, pt. 1; Chelonia, 1849, by Owen and Bell; British Fossil Echinodermata, pt. 3; Carboniferous Brachiopoda, pt. 5; Reptilia of the Wealden Formation, pt. 5; Palyzoa of the Crag, 1859 (from Mr. H. Willett); Natural History of Hastings and St. Leonard's and the Environs, and First Supplement (from Rev. E. N. Bloomfield); Primitive Industry, by C. Abbott (from Peabody Institution, Salem, Mass., U.S.A.); Report of Smithsonian Institution (from the Department of the Interior, Washington, U.S.A.); An Ancient Bird and its Fossil Allies, by Miss Crane (from the Authoress); Bulletin de Séance de la Societé Belge de Microscopie; Bulletin Astronomique et Météorologique de l'Observatoire Imperial a Rio Janeiro; Proceedings of Geological Association, vol. 7, No. 6 and 7; Proceedings of Natural History Society of Glasgow, vol. 5, pt. 1 (from the respective Secretaries); the Atomic Theory, by Ad. Wurtz (from Mr. C. F. Dennet).

The following Books have been purchased during the year:—

Sketches at Home (Geikie); Primæval World of Switzerland (Professor Heer); Animal Intelligence (C. J. Romanes); Human Faculty and its Development (Galton); Studies in Microscopical Science (Cole); Voyage of Challenger, vol. 5; American Ornithology (Wilson and Buonaparte); Recent Advances in Physical Science (Tait); Man before Metals; Forest Scenery (Gilpin); Ants, Bees, and Wasps (Sir J. Lubbock); Origin and Metamorphoses of Insects (Sir J. Lubbock); Wild Flowers considered in relation to Insects (Sir John Lubbock); History of Harting (Gordon); British Aphides, vol. 4 (Buckton).

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER, 1863.

Aylen, S.
Abbey, H.

Bellingham, C.
Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe
Bishop, J. G.
Botting, W.
Brinton, R.
Benson, G. F.
Barnes, J.
Baker, J. S.
Buchel, C.
Burrell, W. H.
Baber, Dr. E. C.
Bostel, D. T.
Barrow, G. S. M.
Burrows, Seymour

Clark, J. Colbatch
Cross, Rev. J. H.
Cox, A. H.
Capon, J.
Corfe, Dr.
Challen, W.
Champion, F. S.
Comlidge, T.
Caush, D. E.
Chapman, E.
Clifton, Lord
Coningham, — Jun.
Clark, F. G.

Dennant, J.
Davey, H.
Dennet, C. F.
Davis, H. C.
Day, Rev. H. G.
Duke, F.
Denman, S.

Edmonds, H.
Evans, George
Eisenhofer, A. A.
Evett, G. A.
Ewart, Dr. Joseph

Fox, O. A.
Friend, D. B.
Friend, Daniel
Fisher, S. W.
Freeman, C. G.

Glaisyer, T.
Glaisyer, R.
Glaisyer, J. H.

Hallifax, Dr.
Hollis, W. M.
Hadlow, F. V.
Haselwood, J. E.
Hallett, W. H.
Hart, E. J.
Hurst, H.
Hobbs, J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hannington, Rev. J.
Hoadly, A.
Holloway, A.
Hamblin, J.
Haynes, J. L.
Henriques, A.
Hawes, H.

Infield, H. J.

Jackson, W.
James, R. A.

Leuliette, L.
Lee, W. R.
Lomax, B.
Lucas, J. E.
Langton, H.
Lockyer, G. R.

Merrifield, F.
Marshall, E. J.
Mayall, J. J. E.
Mills, P.
Mitchell, W. W.
Millard, Dr. W. J. K.
Morris, J.
Medcalf, E. S.
Mills, A.
Marchant, W.
Merry, W.
Miles, Dr. E. J.
Moon, Dr. W.
McKellar, Dr.
Merrifield, C. W.

Nash, W. H.
Nye, H.
Nourse, W. E. C.
Norman, S.

Newnham, J. M.

Phillips, B.
Pocock, C. J.
Pratt, H.
Pankhurst, E. A.
Puttick, W.
Poundall, W. L.
Parton, F.
Peek, R.
Petitfourt, E. J.

Ross, Dr. Harris
Rutter, Dr.
Ross, Dr. Douglas
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodham
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E. E.
Simonds, T. R.
Salzmann, F. W.
Stride, J. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Smith, Dr. Tyler

Thomas, D.
Tasker, J.

Verrall, Henry
Verrall, Hugh J.

Winter, J. N.
Wallis, M.
Wallis, W. C.
Wallis, E. A.
Wood, W. R.
Wood, W. R., Jun.
Wood, J.
Williams, H. M.
Woodman, James
Wilkinson, T.
Willett, H.
Wellbyc, H.
Walker, T.
Wood, F.
Webster, W.

HONORARY MEMBERS.

Bloomfield, Rev. E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Jenner, J. H. A.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
Prince, C. L.
Stevens, Dr.
Ward, J. Clifton

LADY SUBSCRIBERS.

Barnard, Miss
Woollams, Mrs. Henry

SOCIETIES ASSOCIATED,

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Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institution, Washington, U.S.A.
Société Belge de Microscopie, Bruxelles.
Watford Natural History Society.

TREASURER'S ACCOUNT.

For the Year ending 30th of September, 1883.

Dr.

	£	s.	d.
To Books and Periodicals	31	7	3
,, Printing Circulars, &c.	11	17	6
,, Stationery, Postages, &c.	4	15	6
,, Fire Insurance	0	12	0
,, Bookbinding	2	10	2
,, Microscope	16	5	0
,, Messenger delivering Notices	3	3	0
,, Commission to Collector for Subscriptions	1	19	4
,, Assistant Secretary	1	10	0
,, Gratuities to Assistants at Museum	2	15	0
,, Expenses of Soirée	17	8	3
,, Expenses of Annual Excursion	1	1	6
,, Sundries	0	4	8
,, Balance in hands of Treasurer	110	13	0
	£206	2	2

Cr.

	£	s.	d.
By Balance in hands of Treasurer	129	11	8
,, Annual Subscriptions	65	0	6
,, Arrears due 1st October, 1882	5	10	0
,, Entrance Fees	6	0	0
	£206	2	2
,, Balance brought over	£110	13	0

Examined and found correct, 8th of October, 1883.

ROBERT GLAISYER, }
JAS. WM. STRIDE, } AUDITORS.

Frc.

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society

FOR THE

YEAR ENDING 30TH SEPTEMBER, 1884.

Adopted at a Meeting held on Thursday, October 9th, 1884.

Brighton:
PRINTED AT THE "GUARDIAN" HYDRAULIC WORKS, 34, NORTH STREET.

1884.

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1884.

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DR. JOSEPH EWART.

Vice-Presidents:

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MR. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
MR. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. J. J. E. MAYALL,
HON. HOWE BROWNE,
REV. H. G. DAY,
DR. W. A. HOLLIS.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
DR. CORFE,
DR. MILES,
MR. F. E. SAWYER,
MR. E. J. PETITFOURT.

Honorary Secretaries:

MR. BENJAMIN LOMAX,
11, PARK CRESCENT TERRACE.

MR. J. COLBATCH CLARK,
64, MIDDLE STREET.

Honorary Librarian and Curator:

MR. R. GLAISYER,
112, QUEEN'S ROAD.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, October 9th, 1884,

IT WAS RESOLVED,—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the Minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Dr. Joseph Ewart; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, Mr. F. E. Sawyer, and Mr. E. J. Petitfourt; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark; Honorary Librarian and Curator: Mr. Robert Glaisyer.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, Honorary Secretaries, and Honorary Librarian, for their services during the past year.

That the thanks of this Meeting be presented to Dr. W. A. Hollis for his able conduct as President during the past year.

ANNUAL REPORT

OF THE

Brighton & Sussex Natural History Society.

Your Committee are pleased to be able to report the continued prosperity of the Society during the year which terminated on the 30th September, 1884.

The Financial condition of the Society is very satisfactory, there being now a balance in the hands of the Treasurer amounting to £119 17s. 8d. A statement of the Accounts for the year is annexed.

The number of Members has remained the same as last year. A list of the present Members is appended to this Report.

A list of the Books which have been presented to the Society during the year, and also of the Books purchased during the year, is appended to this Report.

The Conversazione was held at the Royal Pavilion on the 19th of March, and was very successful, having been attended by 353 Members and Friends.

The Field Excursions during the year have been as follows :—

1883.—October 13th, to Hassock's Gate.
1884.—May 10th, to Lewes.
" June 14th, to East Grinstead.
" July 19th, to Keymer, when the Members were most hospitably entertained by their fellow Member, Mr. Shaw.

1884.—August 16th, to Chailey.

„ September 13th, to Newhaven.

The Annual Excursion took place on the 8th of July, to Petworth and Bignor, when there was a large attendance, and a very pleasant day was spent.

The Papers read before the Society during the past Session, as shewn by the appended list, have possessed more than usual interest and importance. Without wishing to make invidious selections from a series where all the papers were good, your Committee would specially draw your attention to the originality and comprehensive grasp of the subject displayed by Dr. Joseph Ewart in the treatment of his paper on "Poisonous Snakes and their Poisons." The classification of the Corals of the Brighton Museum has been entrusted to Dr. Miles, and in an essay thereon, read before the Society in February last, he has shewn the value, in such cases, of steady painstaking industry, when it is guided by a true spirit of scientific research. One of our readers, the Rev. J. Hannington, has been recently elevated to a Central African See. May we not learn, from this result of his labours, how the pursuit of Natural History is consistent with highest phases of Missionary life? Two evenings during the Session were occupied by Mr. Seymour Burrows. This gentleman, in his intelligible discourse on the Diatoms, and in his subsequent microscopical demonstration of them, shewed a knowledge of the subject attained by few. Geology and Palæontology have not been neglected by our Members, as the interesting remarks of Mr. Edward Crane and Dr. Corfe can testify. Considered as a whole, the papers have displayed great scientific knowledge and training, and your Committee trust that the high standard attained by the papers during the past Session may be upheld in forthcoming ones, and that the Members generally may shew by increased attendance at the Meetings that they have a genuine interest in the welfare of the Society.

The following subjects have been introduced at the Microscopical Meetings:—

1883.—October: A Demonstration of the Chief Methods of preparing Stained Sections of Animal Tissues and Organs, by Mr. T. W. Groves, Demonstrator of Practical Biology, &c., at King's College, London. In this Lecture, which proved most interesting and instructive, the manipulations were performed with great skill, and valuable hints were thrown out in all branches of the subject.

„ November: Common Rush (Juncus Communis), by Mr. Benjamin Lomax.

1884.—January: Dog's Tongue, by Mr. E. J. Petitfourt.

„ March: Specimens of Spleen, by Mr. E. J. Petitfourt.

„ September: Bulrush (Typha), by Mr. E. J. Petitfourt.

Living Specimens exhibited by Mr. Haselwood on Microscopical nights have proved very attractive, and Mr. G. D. Sawyer, Mr. Seymour Burrows, Dr. Winter Fisher, and others have contributed to the interest of the Meetings. An increase in the number of exhibitors and others interested in this Branch would, however, be welcomed by those who at present take a share in the proceedings.

The thanks of the Society are due to Mr. E. J. Petitfourt for the able way in which he has introduced the subjects at the Microscopical Meetings.

The Committee have again to record their thanks to the Government Departments of the United States and the Smithsonian Institute for their great and continued liberality in forwarding valuable reports and other papers.

The Committee wish to record their high appreciation of the services rendered to the Society by Dr. Hollis, not only by the valuable papers he has contributed, but also by his constant attendance and the able and courteous manner in which he has discharged the duties of the office of President during the past two years.

The following is a list of the papers read at the Ordinary Meetings :—

1883.—October : "Birds and their Uses in the Economy of Nature," by Mr. F. Fuller.

„ November : "Poisonous Snakes and their Poisons," by Dr. Joseph Ewart, M.R.C.P.

„ December : "A Fight for Life amid Rocks : a Phase in the Evolution Controversy," by Dr. W. A. Hollis.

1884.—January : "The state of Natural Science at Rome about the time of Christ," by Mr. E. A. Pankhurst.

„ February : "Some remarks on the Brighton Museum Corals and Corals in General," by Dr. Miles.

„ March : "A Naturalist's Ramble in Central Africa," by the Rev. J. Hannington.

„ April : "Diatomaceæ," by Mr. Seymour Burrows.

„ May : "Remarks on some recent Osteological Additions to the Brighton Museum from Kent's Cavern and elsewhere," by Mr. Edward Crane, F.G.S.—At this meeting Dr. Corfe exhibited some human bones of ancient date found near the Dyke Road, Brighton.

„ June : "Sussex Dialect and Speech," by Mr. Fredk. E. Sawyer, F.R. Met. Soc.

„ September : "Reptiles," by Mr. Benj. Lomax, C.E.

Presentations of the following Books and Papers have been received during the year :—

A Paper on Poisonous Snakes and their Poisons, by Dr. Ewart, read before the Society on the 8th November, 1883 (from the Author); A Paper on the Brighton Museum Corals and Corals in General, by Dr. Miles, read before the Society on the 14th February, 1884 (from the Author); Atomic Theory, by A. D. Wurtz (from Mr. C. F. Dennet); Leisure Hour, Sept., 1883, containing Life of Professor Owen (from Miss Crane); Sussex Fish and Fisheries, Sussex Natural History Folk-Lore and Superstitions, Sussex Folk-Lore and Customs connected with the Seasons, by F. E. Sawyer, F.M.S. (from the Author); Folk-Lore Journal, July, 1883 (from Mr. F. E. Sawyer); Carcinologiske Bidrag til Norges Fauna, 1879, by G. O. Sars; Vœxtlivet I Norge, by Dr. F. C. Schübeler, 1879; Die Anämie, by S. Laache, 1883; Enumeratio Insectorum Norvegicorum, 1877 and 1880, by H. Siebke; Krystallographisk-Chemiske Undersogelser, by Th. Hiortdahl (from the Royal University of Norway); Etudes sur les nouvesments de L'Atmosphère, by C. M. Guldbergem H. et Mohm, 2nd part, 1880; Fossil Arachnidæ, by Rev. P. B. Brodie, F.G.S.; Position of the Silurian, Devonian, and Carboniferous Rocks in the London Area; The Chalk of the Southern Part of Dorset and Devon, The Cliff Sections of the West of Dieppe and at Newhaven, by W. Whitaker, F.G.S.; Notes on the British Palæozoic Crustacea (Merostomata), by H. Woodward, F.G.S.; On a Flint Implement found at Barnwell, Cambs., by A. F. Griffith, B.A.; Cambridgeshire Geology, by T. G. Bonney, F.G.S.; On the Plumules or Battledore Scales of the Lepidoptera, by J. Watson; Withered Leaves, by J. W. Fisher; Notes on Four Series of Palæolithic Implements from South-Africa, by C. J. Rickard, communicated by A. F. Griffith, B.A.; Section at Hordwell Cliffs, by the late E. B. Fawney, M.A., and H. Keeping; On the Aims and Prospects of the Study of Anthropology, by W. H. Flower, LL.D., F.R.S.; Fifty Years' Retrospect of British Art, Pictorial, Decorative, and Industrial, by G. Wallis, F.S.A. (from Mr. H. Willett); Announcement of the Wagner Free Institute of Science, Philadelphia, 1883 (from Mr. C. P. Sherman); Summary of a Meteorological Journal kept by C. L. Prince, Esq. (from the

Author); Proceedings and Transactions of Croydon Microscopical and Natural History Club, 1883; Report of Belfast Natural History Society, 1882-83; Proceedings of the Chester Society of Natural Science, 1883-84; Proceedings of Natural History Society of Glasgow, vol. 5, pt. 2, 1881-82; Transactions of Eastbourne Natural History Society, 2 pts., January and May, 1883; Bulletin de la Société Belge de Microscopie, 5 numbers; Bulletin Astronomique et Meteorologique Rio de Janeiro, 2 pts., 1883; Proceedings of Royal Microscopical Society and List of Members, 1884; Journal of Quekett Microscopical Club; Proceedings of Geologists' Association; Report of Cardiff Naturalists' Society, 1883; Report of North Staffordshire Naturalists' Field Club, 1883; Proceedings of Geologists' Association, Nos. 5 and 6, and Report for 1883; Proceedings of Warwickshire Field Club, 1880 (from the Secretaries of the respective Societies; Report of Smithsonian Institution, 1882 (from the Institution); Report of the Geological Survey of the United States (from the Department of the Interior).

A presentation of 18 slides for the microscope has been received from Rev. Clarke Smith.

The following Books have been purchased during the year:—

Reports of the Challenger Expedition, 5 vols.; Ancient Scottish Lake Dwellings (Robt. Munro); Siberia in Asia (Seebohm). Ammonites of the Lias, by T. Wright, F.R.S., pt. V., 1882, VI., 1883; Brachiopoda, Devonian and Silurian, by T. Davidson, F.R.S., vol. 5, pt. I., 1882, II., 1883; Echinodermata Cretaceous, by T. Wright, F.R.S., vol. I., pt. X., 1882; Flora Eocene, British, by J. S. Gardner, F.G.S., vol. I., pt. III., 1882, vol. 2, pt. I., 1883; Mollusca Crag, by S. V. Wood, 1882; Trigoniæ Fossil, by the late J. Lycett, L.R.C.P.E., Supplement No. 2; Trilobites, Cambrian, Silurian, and Devonian, by the late J. W. Salter, A.L.S., pt. V., 1883; Trilobites Carboniferous, by H. Woodward, F.R.S., pt. I., 1883 (issued by the Palæontographical Society).

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society,

OCTOBER, 1884.

Aylen, S.
Abbey, H.

Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe
Bishop, J. G.
Botting, W.
Brinton, R.
Benson, G. F.
Barnes, J.
Baker, J. S.
Buchel, C.
Baber, Dr. E. C.
Bostel, D. T.
Barrow, G. S. M.
Burrows, Seymour
Clark, J. Colbatch
Cox, A. H.
Capon, J.
Corfe, Dr.
Champion, F. S.
Caush, D. E.
Chapman, E.
Clifton, Lord
Coningham, W. J. C.
Clark, F. G.
Campbell, A.

Dennant, J.
Davey, H.
Dennet, C. F.
Davis, H. C.
Day, Rev. H. G.
Duke, F.
Denman, S.

Edmonds, H.
Evans, George
Eisenhofer, A. A.
Evett, G. A.

Ewart, Dr. Joseph

Fox, O. A.
Friend, D. B.
Friend, Daniel
Fisher, S. W.
Freeman, C. G.

Glaisyer, T.
Glaisyer, R.
Glaisyer, J. H.

Hallifax, Dr.
Hollis, W. M.
Hadlow, F. V.
Haselwood, J. E.
Hallett, W. H.
Hart, E. J.
Hurst, H.
Hobbs, J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hannington, Rev. J.
Hoadly, A.
Hamblin, J.
Haynes, J. L.
Henriques, A.
Hawes, H.

Infield, H. J.

Jackson, W.
James, R. A.

Poundall, W. L.
Parton, F.
Petitfourt, E. J.

Ross, Dr. Harris
Rutter, Dr.
Ross, Dr. Douglas
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodman
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E. E.
Simonds, T. R.
Salzmann, F. W.
Stride, J. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Smith, Dr. Tyler

Thomas, D.
Tasker, J.

Verrall, Henry
Verrall, Hugh J.

Winter, J. N.
Wallis, M.
Wallis, W. C.
Wallis, E. A.
Wood, W. R.
Wood, W. R., Jun.
Wood, J.
Williams, H. M.
Woodman, James
Wilkinson, T.
Willett, H.
Wellbye, H.
Walker, T.
Wood, F.
Webster, W.
Walter, Jno.
Wright, A.

HONORARY MEMBERS.

Bloomfield, Rev. E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Jenner, J. H. A.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
Prince, C. L.
Stevens, Dr.
Ward, J. Clifton

LADY SUBSCRIBERS.

Woollams, Mrs. Henry

SOCIETIES ASSOCIATED,

WITH WHICH THE SOCIETY EXCHANGES PUBLICATIONS,

And whose Presidents and Secretaries are *ex-officio* Members of the Society :—

Barrow Naturalists' Field Club.
Belfast Naturalists' Field Club.
Belfast Natural History and Philosophical Society.
Boston Society of Natural Science (Mass., U.S.A.)
Cardiff Naturalists' Society.
Chester Society of Natural Science.
Chichester and West Sussex Natural History Society.
Croydon Microscopical Society
Department of the Interior, Washington, U.S.A.
Eastbourne Natural History Society.
Edinburgh Geological Society.
Epping Forest and County of Essex Naturalists' Field Club.
Folkestone Natural History Society.
Geologist's Association.
Glasgow Natural History Society.
Glasgow Society of Field Naturalists.
Leeds Naturalists' Club.
Lewes and East Sussex Natural History Society.
Maidstone and Mid Kent Natural History Society.
North Staffordshire Naturalists' Field Club.
Peabody Academy of Science, Salem, Mass., U.S.A.
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institution, Washington, U.S.A.
Société Belge de Microscopie, Bruxelles.
Watford Natural History Society.

TREASURER'S ACCOUNT

For the Year ending 30th September, 1884.

Dr.

	£	s.	d.
To Books and Periodicals	17	6	0
,, Printing Circulars, &c.	15	15	3
,, Stationery, Postages, &c.	4	11	8
,, Fire Insurance	0	12	0
,, Bookbinding	0	17	8
,, Messenger delivering Notices	3	12	0
,, Commission to Collector for Subscriptions ...	1	17	6
,, Assistant Secretary	3	4	6
,, Gratuities to Assistants at Museum	2	15	0
,, Expenses of Soirée	13	10	0
,, Expenses of Annual Excursion	0	7	3
,, Bag for Books	0	14	6
,, Polariscope	0	10	6
,, Carriage of Books	0	6	10
,, Lamp, Spirit, and Glasses for Microscopes ...	0	4	4
,, Sundries	0	1	4
,, Balance in hands of Treasurer	119	17	8
	£186	4	0

Cr.

	£	s.	d.
By Balance in hands of Treasurer	110	13	0
,, Annual Subscriptions	61	10	0
,, Arrears due 1st October, 1883	10	10	0
,, Entrance Fees	3	10	0
,, Overpayment of Subscriptions...	0	1	0
	£186	4	0
,, Balance brought over	119	17	8

Examined and found correct, 6th October, 1884.

ROBERT GLAISYER, } AUDITORS.
OCTAVIUS A. FOX, }

Abr 131.

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society,

October, 1884, to June, 1885.

Adopted at a Meeting held on Thursday, June 11th, 1885.

Brighton:
D. O'CONNOR, PRINTER, "GUARDIAN" OFFICE, 34, NORTH STREET.

1885.

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society,

OCTOBER, 1884, TO JUNE, 1885.

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1885.

HARVARD COLLEGE LIB
INGRAHAM FUND
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DR. JOSEPH EWART.

Vice-Presidents:

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Mr. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
Mr. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
DR. BADCOCK,
MR. J. J. E. MAYALL,
HON. HOWE BROWNE,
REV. H. G. DAY,
DR. W. A. HOLLIS.

Honorary Treasurer:

MR. THOMAS GLAISYER,
12, NORTH STREET.

Committee:

MR. C. F. DENNET,
MR. E. A. PANKHURST,
DR. CORFE,
DR. MILES,
MR. F. E. SAWYER,
MR. E. J. PETITFOURT

Honorary Secretaries:

MR. BENJAMIN LOMAX,
PARK ROAD WEST.

Mr J. COLBATCH CLARK,
64, MIDDLE STREET.

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JUN 10 1942

President:

DR. JOSEPH EWART.

Vice-Presidents:

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Mr. BIGGE,
DR. HALLIFAX,
MR. SIMONDS,
MR. W. E. C. NOURSE,
MR. T. GLAISYER,
MR. F. MERRIFIELD,
MR. HASELWOOD,
Mr. ALD. COX,
MR. J. DENNANT,
MR. G. D. SAWYER,
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MR. J. J. E. MAYALL,
HON. HOWE BROWNE,
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MR. E. J. PETITFOURT

Honorary Secretaries:

MR. BENJAMIN LOMAX,
PARK ROAD WEST.

Mr J. COLBATCH CLARK,
64, MIDDLE STREET.

At the Annual Meeting of the BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY, held in the Curator's Room, Free Library and Museum, Church Street, June 11th, 1885,

IT WAS RESOLVED.—

That the Report and Treasurer's Account, now brought in, be received, adopted, and entered on the Minutes, and printed for circulation as usual.

That the following gentlemen be elected as Officers of the Society for the ensuing year:—President: Dr. Joseph Ewart; Treasurer: Mr. Thomas Glaisyer; Committee: Mr. C. F. Dennet, Mr. E. A. Pankhurst, Dr. Miles, Dr. Corfe, Mr. F. E. Sawyer, and Mr. E. J. [illegible]; Honorary Secretaries: Mr. B. Lomax and Mr. John Colbatch Clark.

That the sincere thanks of this Meeting be given to the Vice-Presidents, Treasurer, Committee, and Honorary Secretaries for their services during the past year.

That the thanks of this Meeting be presented to Dr. Joseph Ewart for his able conduct as President during the past year.

ANNUAL REPORT

OF THE

Brighton & Sussex Natural History Society.

At a Special General Meeting of the Society held on the 11th of December last it was resolved that the Annual General Meeting shall be held in June instead of October, so that this report only relates to the time which has elapsed since October last instead of for the whole year.

It is with very deep regret that the Committee record the death of Mr. Robert Glaisyer, who for many years acted as Honorary Librarian and Curator of the Society. He became a member of the Society on the 12th day of August, 1858, and has from that time taken an active interest in promoting its welfare. He has from time to time prepared catalogues of the books in the Library, and has always been most diligent and careful in looking after the books and periodicals. He rendered most efficient assistance in the arrangements for the Soirees, and has in many other ways devoted much time and attention to the affairs of the Society.

The Committee have not yet succeeded in finding a successor to Mr. Glaisyer in the offices of Hon. Librarian and Curator, but hope to do so during the ensuing vacation.

With a view to promoting the study of Natural History, your Committee have offered prizes of three guineas and two guineas to the Candidates presenting the two best Essays on- "The main features of the Physiography of the Brighton District together with a description of any rare Animals or Plants peculiar

Presentations of the followi
received from October, 1884, to M

Belfast Natural History
Belfast Natural History and Philos
the, 1883-84 ; Bulletin de la Socie
year, Nos. 3, 4, and 5 ; Chichest
History and Microscopical Society
C. F., Esq., Report on the Total So
and January 11th, 1880, and Photo
Petworth ; Eastbourne Natural H
actions, parts 5 and 6 ; Essex Field
Natural History Society's Proceedi
Cathedral Yard, Manchester, Descri
Sale at ; Geological Association, Pro
Index for vol. 8 of Proceedings ; H
Transactions of the, pt. 1, 1883; Muse
Sciences, Davenport Iowa, Putman,
Museum (pamphlet), 1885 ; New York
of the, vol. 1., No. 2 ; Peabody Academ
1874 to 1884 ; Postal Microscopical
Prince, C. L., Esq., Crowborough, Su
logical Journal ; Queket Microscop
vol. 2, No. 10 ; Smithsonian Instituti
London Microscopical and Natural
Report ; United States Geological
Interior, 3rd Annual Report ; Will
Bulletin de Musée Royale D'Histoire
Quarterly Journal of Geological Societ
Archæology in the Mersey district, 18
ation Committee's 3rd Report ; Potter
Geology of the Cheshire Coast ; Frittor
tions of the Beds between the Chalk
in the S.E. of England ; Yorkshire Phil
Report, 1884 ; Chester Society of
Report, 1884 ; Ray Society, Report of

1884.—November : "Epithelium," by Mr. E. J. Petitfourt.

1885.—April : "Hepatice," by Mr. C. P. Smith.

Specimens have been exhibited at the Meetings by Mr. J. E. Haselwood, Mr. G. D. Sawyer, Dr. Winter Fisher, Mr. H. V. Shaw and other Members.

The Committee have again to record their thanks to the Government Departments of the United States and the Smithsonian Institute for their great and continued liberality in forwarding valuable reports and other papers.

The Ordinary Meetings in October, 1884, and May, 1885, were devoted to the Exhibition of Specimens, and the following is a list of the papers read at the other Ordinary Meetings :—

1884.—November : On (1) "The Lowest Forms of Living Things ; (2) Physiology ; (3) The Aboriginal Races of India," being an Inaugural Address by Dr. Ewart, F.R.C.P.

„ December : "Notes on the appearance of Anchovies on the Sussex Coast in November, 1884," and "Supplemental Notes on Sussex Fish and Fisheries," by Mr. Fredk. E. Sawyer, F.R. Met. Soc.

1885.—January : "Electric Railways : How made and how worked, with experimental Illustrations," by Mr. E. A. Pankhurst.

„ February : "Time Division and Time Reckoning," by Mr. Henry Pratt, F.R.A.S.

„ March : "Anglo-Saxon Guilds and Norman Crafts," by Dr. Corfe.

„ April : "Hepatice," by Mr. C. P. Smith.

LIST OF M

OF TH

Brighton & Sussex Nat

JUNE,

Aylen, S.
Abbey, H.

Bigge, A.
Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe
Bishop, J. G.
Botting, W.
Brinton, R.
Benson, G. F.
Barnes, J.
Baker, J. S.
Buchel, C.
Baber, Dr. E. C.
Bostel, D. T.
Barrow, G. S. M.
Burrows, Seymour
Branfoot, Dr.
Barker, G. D.

Conference of Delegates of Scientific Societies, Proceedings at, 1884.

The following Books and Periodicals have been purchased during the year :—

Fishe's Excursion of an Evolutionist; Romer's Bones and Caves of Ojcow; Clermont's Quadrupeds and Reptiles; Clermont's Quadrupeds of Europe; Pascoe's Geological Classifications; Hodge's Older England; Saxon Leechdom; Challenger Reports, vols. 10 and 11; Freshwater Algœ; Unity of Nature (Duke of Argyle); Ganot's Physics; Studies in Microscopical Science, vol. 3; English Moss Flora; Geological Magazine; Zoological ditto; Entymologist ditto; Science Gossip; Microscopical Quarterly; 104 numbers of Nature, two years.

[illegible] H.
[illegible]urst, E. A.
[illegible]ck, W.
[illegible]endall, W. L.
[illegible]ton, F.
Petitfourt, E. J.
Postans, R. B.

Ross, Dr. Harris
Rutter, Dr.
Ross, Dr. Douglas
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Roper, F. C. S.
Rose, T., Sen.
Rose, T.
Rean, W. H.

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodman
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E. E.
Simonds, T. R.
Salzmann, F. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Smith, Dr. Tyler
Stephens, Dr. W. J.
Salmon, E. F.

Thomas, D.
Tasker, J.
Thomas, J.

Verrall, Henry
Verrall, Hugh J.

Winter, J. N.
Wallis, M.
Wallis, W. C.
Wallis, E. A.
Wood, W. R.
Wood, W. R., Jun.
Wood, J.
Williams, H. M.
Woodman, James
Wilkinson, T.
Willett, H.
Wellbye, H.
Walker, T.
Wood, F.
Webster, W.
Walter, Jno.
Wright, A.
Whittle, Dr. E. G.

HONORARY MEMBERS.

Bloomfield, Rev. E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Jenner, J. H. A.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
Prince, C. L.
Stevens, Dr.
Ward, J. Clifton

LADY SUBSCRIBER.

Woollams, Mrs. Henry

SOCIETIES

WITH WHICH THE SOCIETY

And whose Presidents and Secre
the Soci

Barrow Naturalists' Field Cl
Belfast Naturalists' Field Clu
Belfast Natural History and
Boston Society of Natural Sci
Cardiff Naturalists' Society.
Chester Society of Natural Sc
Chichester and West Sussex
Croydon Microscopical Societ
Department of the Interior, W
Eastbourne Natural History S
Edinburgh Geological Society.
Epping Forest and County of
Folkestone Natural History Sc
Geologists' Association.
Glasgow Natural History Socie
Glasgow Society of Field Natu
Huddersfield Naturalist Societ
Leeds Naturalists' Club.
Lewes and East Sussex Natural
Maidstone and Mid Kent Natu
North Staffordshire Naturalists'
Peabody Academy of Science, S
Quekett Microscopical Club.
Royal Microscopical Society.
Royal Society.
Smithsonian Institution, Washing
South London Microscopical and
Société Belge de Microscopie, Br
Watford Natural History Society.
Yorkshire Philosophical Society.

TREASURER'S ACCOUNT.

RECEIPTS.

Cr.

	£	s.	d.
By Balance last year	119	17	8
,, Annual Subscriptions, 1884-5	56	0	0
,, Arrears due October 1st, 1884, since received	7	10	0
,, Entrance Fees	4	10	0
,, Over-payment of Subscription	0	0	6
,, Sale of Copy of Proceedings	0	2	0
	£188	0	2
Balance	128	18	0

EXPENDITURE.

Dr.

	£	s.	d.
To Books	16	4	4
,, Subscriptions	7	6	0
,, Printing	11	6	9
,, Insurance	0	12	0
,, Salaries and Gratuities	6	13	0
,, Commission of Collector	2	0	6
,, Postage	1	1	1
,, Expenses of Soirée	13	18	6
,, Balance	128	18	0
	£188	0	2

Audited with Books and Vouchers, June 1st, 1885; correct.

F. G. CLARK, *Auditor.*

Aug. 7. 8

ANNUAL REPORT

OF THE

BRIGHTON AND SUSSEX

Natural History Society,

JUNE, 1885, to JUNE, 1886.

Adopted at a Meeting held on Thursday, June 10th, 1886.

Brighton:
THE SOUTHERN PRINTING COMPANY, 130, NORTH STREET.

1886.

HARVARD CO
INGRAH
JUN 1

All communications relating
should be sent to the Science S
PANKHURST, F.G.S., 12, *Clifton*

All communications relating t
or any other business matter per
books, &c., connected with the Libr
the Hon. Librarian, MR. D. E. C
the Free Library, Church Street, B

Presentations of objects for t
sent to the Hon. Curator, MR. I
Library, Church Steeet, Brighton.

Subscriptions should be paid,
the financial affairs of the Society sh
JOHN COLBATCH CLARK, *No.* 64,

President :

Dr. JOSEPH EWART.

Vice-Presidents :

Mr. HOLLIS,
Mr. SIMONDS,
Mr. W. E. C. NOURSE,
Mr. T. GLAISYER,
Mr. F. MERRIFIELD,
Mr. HASELWOOD,
Mr. Alderman COX,
Mr. J. DENNANT,
Mr. G. D. SAWYER,
Dr. BADCOCK,
Mr. J. J. E. MAYALL,
Hon. HOWE BROWNE,
Rev. H. G. DAY,
Dr. W. A. HOLLIS.

Honorary Treasurer :

Mr. THOMAS GLAISYER,
12, North Street.

Committee :

Mr. C. F. DENNET,
Mr. E. A. PANKHURST,
Dr. CORFE,
Dr. MILES,
Mr. F. E. SAWYER,
Mr. E. J. PETITFOURT.

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Honorary Librarian :

Mr. D. E. CAUSH.

Honorary Curator :

Mr. BENJAMIN LOMAX.

Science Secretary :

Mr. EDWARD ALLOWAY PANKHURST,
12, Clifton Road.

Honorary Secretary :

Mr. J. COLBATCH CLARK,
64, Middle Street.

At the Annual Meeting

NATURAL HISTORY SOCIETY, I

Library and Museum, Church S

IT WAS RESOLVED,—

That the Report and Trea
be received, adopted, and enter
for circulation as usual.

That the following gentlen
Society for the ensuing year :–
Treasurer : Mr. Thomas Glais
Burrows, Mr. C. F. Dennet, M
E. J. Petitfourt, and Mr. F. E.
Mr. D. E. Caush ; Honorary
Secretary : Mr. John Colbatch
E. A. Pankhurst.

That the sincere thanks of
Vice-Presidents, Treasurer, Con
Honorary Curator, Honorary Se
for their services during the past

That the thanks of this Meet
Ewart for his able conduct as Pres

ANNUAL REPORT

OF THE

Brighton & Sussex Natural History Society.

In presenting their annual report, your Committee have the pleasure of again recording the continued prosperity of the Society. They deeply regret the loss which the Society has sustained by the death of two of its Vice-Presidents, viz., Mr. A. Bigge and Dr. Hallifax; who had been connected with the Society for upwards of 30 years and who at one time took an active part in promoting its prosperity.

Financially, the condition of the Society is very satisfactory, there being a balance of £133 1s 7d in the hands of the Treasurer. Annexed to this report is a statement of the receipts and expenditure for the past year. The number of members remains about the same. A list of the present members is appended to this report.

Presentations of the following books and papers have been received by the Society during the year:—

The Data of Ethics, by H. Spencer; Astronomy, by F. Arago, 2 vols; The Natural History of Creation (from Mr. E. Hamblin); Physical Diagnosis, by Loomis; Zoological Recreations, by Broderip; Water Analysis, by Wanklyn; The Sterescope, by Brewster; Geological Terms, by Page; British Ferns, by Johnson; Stones of the Valley, Symonds; British Butterflies, by Coleman;

Microscopical Objects, by Prit
Martin ; Naturalists' Note Bo
teis) ; List of Land and Fresh
J. H. A. Jenner ; Forestry i
words upon (1) The lowest for
(3) Aryan and Aboriginal races
recently discovered Insecta fro
by H. Goss (from the respecti
Geological Association ; Reports
Staffordshire Naturalists' Field
The Belfast Naturalist Field C
Society ; Bulletin de la Societé
respective Societies) ; Quekett
Hailes) ; Topography of Crowb
Author) ; Annalen des K. K
redigirt von Dr. F. R. von Haue

The following books and pe
chase during the year, viz :—

CHALLENGER REPORT, Vol I
EVOLUTION IN THE MIND O
GREVILLEA, Vol. XIV.
ENTOMOLOGISTS' MONTHLY M
GEOLOGICAL MAGAZINE.
ZOOLOGIST MAGAZINE.
CARRINGTON'S ENTOMOLOGIS
SCIENCE.
SCIENCE GOSSIP,
MICROSCOPICAL QUARTERLY.
NATURE.
STUDIES IN MICROSCOPICAL

Mr. Douglas E. Caush has k
Hon. Librarian, formerly held by
whose death was recorded in t
supervision, and with the assista
Miles, and Mr. Pankhurst (the
Library, which now consists of a

unbound current periodicals and pamphlets, has been entirely re-arranged and a new catalogue has been prepared and will shortly be issued to the members.

A change in the officers of the Society has also taken place, Mr. Lomax, one of the Hon. Secs. finding that his public duties prevented his taking so active a part in the work of the Society as he wished to do, resigned his office, but the Committee are glad to state that he has accepted the office of Hon. Curator. Arrangements were made by the Committee, under which Mr. E. A. Pankhurst was appointed Science Secretary. The Society is much indebted to Mr. F. G. Clark for his kindness in auditing the accounts.

The competition for the prizes offered by the Committee for the two best essays on the physiography of the Brighton District, referred to in the last report, cannot be said to have been a success, only one essay having been sent in and that not being of sufficient merit to enable the Committee to award the writer a prize.

The Committee for various reasons have thought it desirable to discontinue holding the Conversazione for the present.

The annual excursion took place on the 7th of July last, when between 30 and 40 members visited Hailsham, Michelam Priory, Eastbourne, and other places in the vicinity, the President and several members of the Eastbourne Natural History Society accompanying them, the excursion proving a most enjoyable one.

The field excursions during the year have been as follows, viz :—

1885.—May 16, to Balcombe.
June 13, to Horsted Keynes.
July 11, to Shoreham and Steyning.
August 15, to West Hoathly.
September 12,—
October 10, to Arundel Park and Forest.

The papers read at the o
varied and interesting. The fol

1885.—October: On "Fore
Address by th
M.R.C.P.

" November: On "C
Vegetable Wor
by Mr. Leopol
International E

" December: On "Th
by Mr. Benjami

1886.—January: On "Foss
Edward Crane,

" February: On "Vol
Mr. Edward All

" April: On "The Atc
ings," by E. J. I

" May: On "Characte
logical Study," b

The Committee are endeavou
the publication of the papers read

At a special general meeting o
of September last the members d
Microscopical meetings on the 4th
resolved that Microscopical subjects
Committee, be introduced occasion
At the Microscopical meeting in Oc
meetings in June, 1885, and March, 1
following objects and specimens wer
Polycistina, by Mr. J. E. Haselwoo
J. Petifourt, B.A.; Section through
Section of Lung, by Mr. H. Edmonds,

by Mr. Edward Alloway Pankhurst; A Dollond Microscope, by Mr. G. D. Sawyer; A Beale's Neutral Tint Reflector, by Mr. C. A. Wells.

Believing that it would tend to increase the usefulness of the Society, the Committee recommend that the name of the Society be changed and other alterations in the rules made, and at a special general meeting to be held on the 17th of June resolutions to that effect will be proposed.

The Committee have again to record their thanks to the Government Departments of the United States and the Smithsonian Institute for their great and continued liberality in forwarding valuable reports and other papers.

The thanks of the Society are due to those gentlemen who have read papers, exhibited objects, or presented books to the Society, and in concluding their report your Committee would urge upon each member to endeavour to promote the welfare of the Society by bringing its merits under the notice of his friends.

◆

LIST OF MEMBERS

OF THE

Brighton & Sussex Natural History Society.

JUNE, 1886.

Aylen, S.
Abbey, H.

Brown, J. H.
Browne, G.
Badcock, Dr.
Black, A.
Boxall, W. P.
Balean, H.
Booth, E.
Browne, Hon. Howe
Botting, W.
Brinton, R.
Benson, G. F.
Barnes, J.
Baker, J. S.
Buchel, C.
Baber, Dr. E C.
Bostel, D. T.
Barrow, G. S. M.
Burrows, Seymour
Branfoot, Dr.
Barker, G. D.
Blaker, T. F. I.

Clark, J. Colbatch
Cox, A. H.
Capon, J.
Corfe, Dr
Champion, F. S.
Caush, D. E.
Chapman, E.
Clifton, Lord
Coningham, W. J. C.
Clark, F. G.
Campbell, A.
Cowell, S.

Dennant, J.
Davey, H.
Dennet, C. F.
Davis, H. C.
Day, Rev. H. G.
Duke, F.
Denman, S.
Daintrey, C. J.
Dodd, A. H.

Edmonds, H.

Evans, George
Eisenhofer, A. A.
Evett, G. A.
Ewart, Dr. Joseph

Fox, O. A.
Friend, D. B.
Friend, Daniel
Fisher, S. W.
Freeman, C. G.

Glaisyer, T.

Hollis, W. M.
Hadlow, F. V.
Haselwood, J. E.
Hallett, W. H.
Hart, E. J.
Hurst, H.
Hobbs, J.
Hack, D.
Hollis, Dr. W. A.
Holder, J. J.
Hamblin, E.
Hamblin, J.
Haynes, J. L.
Henriques, A.
Hawes, H.
Harrison, Dr. W.
Hodgson, Dr.

Infield, H. J.

Jackson, W.

Kilmister, C.

Leuliette, L.
Lee, W. R.
Lomax, B.
Lucas, J. E.
Langton, H.
Lockyer, G. R.
Lever, C.

Marshall, E. J.
Merrifield, F.
Mayall, J. J. E.
Mills, P.
Mitchell, W. W.
Millard, Dr. W. J. K.
Medcalf, E. S.
Mills, A.
Marchant, W.
Merry, W.
Miles, Dr. E. J.
Moon, Dr. W.
McKellar, Dr.
Martin, W. H.

Nash, W. H.
Nye, H.
Nourse, W. E. C.
Norman, S.

Phillips, B.
Pocock, C. J.
Pratt, H.

Pankhurst, E. A.
Puttick, W.
Poundall, W. L.
Parton, F.
Petitfourt, E. J.
Postans, R. B.

Ross, Dr. Harris
Ross, Dr. Douglas
Rutter, Dr.
Ryde, G. W.
Ryde, W.
Rogers, R. S.
Rose, T.
Rean, W. H.
Roberts, Herbert

Smith, C. P.
Smith, T.
Smith, W.
Smith, J. P. M.
Smith, S. J. Woodhan
Savage, W. D.
Savage, W. W.
Sawyer, G. D.
Sawyer, Fredk. E.
Scott, E. E.
Simonds, T. R.
Salzmann, F. W.
Strevens, W. H.
Spooner, C. H.
Sayers, J.
Smith, Dr. Tyler
Stephens, Dr. W. J.
Salmon, E. F.

Thomas, D.
Tasker, J.
Thomas, J.

Verrall, Henry
Verrall, Hugh J.

Winter, J. N.
Wallis, M.
Wallis, W. C.
Wood, W. R.
Wood, W. R., jun.
Wood, J.
Williams, H. M.
Woodman, James
Wilkinson, T.
Willett, H.
Wellbye, H.
Walker, T.
Wood, F.
Webster, W.
Walter, Jno.
Wright, A.
Whittle, Dr. E. G.
Wells, C. A.
Wells, Isaac

HONORARY MEMBERS.

Bloomfield, Rev. E. N.
Clarkson, Rev. G. A.
Curteis, T.
Davis, Dr. W.
Jenner, J. H. A.
Latham, Dr. K. G.
Lee, H.
Mitten, W.
Prince, C. L.
Stevens, Dr.

LADY SUBSCRIBERS.

Bagley, Miss.
Herring, Miss.
Woollams, Mrs. Henry.

BRIGHTON AND SUSSEX NATURAL HISTORY SOCIETY.

Treasurer's Account for the year ending 31st May, 1886.

EXPENDITURE.

Dr.

	£	s.	d.
To Books and Periodicals	13	0	4
,, Printing	15	11	2
,, Stationery and Postage	4	1	3
,, Fire Insurance	0	12	0
,, Messenger for delivering Notices	3	6	0
,, Commission to Collector for Subscriptions ...	2	4	6
,, Assistant Secretary	2	2	0
,, Gratuities to Assistants at Museum	2	15	0
,, Expenses of Annual Excursion	1	18	2
,, Bookcase, Cabinet for Objects, and Letter Receiving Box	18	9	6
,, Subscriptions to Societies	3	2	0
,, Advertising Prize Essay Competition	1	12	0
,, Sundries	0	3	0
Balance in hands of Treasurer	133	1	7
	£201	18	6

RECEIPTS.

Cr.

	£	s.	d.
By Balance in hands of Treasurer	128	18	0
,, Annual Subscriptions, 1885	12	10	0
,, Annual Subscriptions, 1886	56	0	0
,, Arrears	1	10	0
,, Entrance Fees	3	0	0
,, Overpayment of a Subscription	0	0	6
	£201	18	6
Balance brought over in the hands of the Treasurer	133	1	7

Audited June 10th, 1886,
F. G. CLARK.

DIGEST OF THE

LIBRARY REGULATIONS.

No book shall be taken from the Library without the record of the Librarian.

No person shall be allowed to take more than five volumes at any one time, unless by special vote of the Council.

Books may be kept out two months, no longer without renewal, and renewal may not be granted more than once.

A fine of five cents per day is incurred for every volume not returned within the time specified by the rules.

The Librarian may demand the return of a book after the expiration of ten days from the date of borrowing.

Certain books, so designated, cannot be taken from the Library without special permission.

All books must be returned at least two weeks previous to the Annual Meeting.

Each member is responsible for all injury or loss of books charged to his name.

0
13

This book should be returned to the Library on or before the last date stamped below.

A fine of five cents a day is incurred by retaining it beyond the specified time.

Please return promptly.

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